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A WORLD OF POWER

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THE call for a world conference on power last year led to the comment from a world-famed engineer, "What is there international about power?" Energy does not at first thought appear to be an article of world commerce or a subject of international discussion: in power of the kind that



FIGURE 1.—Victoria Falls on the Zambesi River, Rhodesia, Africa. In a vision of the social order of the future when the wheels of world industry shall all turn for the common good, the great water-power resources of Africa stand out prominent and precious. This great continent with its high, extensive plateaus under the heavy, equatorial rain belt will furnish at least 42 per cent of the world's water power. (Courtesy of the Keystone View Co.)

turns wheels for industry and transportation each country is sufficient unto itself; if not it falls behind in world competition.

However, at the London Conference there was staged a review of power resources, nation by nation, that showed a world-wide interest in the national inventories of tons of coal, barrels of oil, and second-feet of water, and beyond this interest arose a vision of the possibility of utilizing these stores of energy for the common good. Nor was this vision one of the distant future, for it was realized how many wheels the world over are already being turned with British coal and American oil. Even now in respect to power no nation lives unto itself.

Such a review of these invaluable sources of energy as was given at London emphasizes their unequal distribution; and the American, whose own country is so well favored by Nature, is impelled to express admiration for the skill and courage with which most of the nations of the world are meeting the ever increasing demand for power. In presenting their inventories the representatives of the European countries made plain their different points of view and different policies—Norway and Sweden have a wealth of water power but no coal; Holland depends upon British coal; Belgium, with a present supply of coal, looks far ahead to water-power development; France is trying to save her coal through large-unit electrification, using both steam and water; Denmark is making general use of electricity derived from British coal and Swedish water; and Italy lacks coal but is utilizing her water powers and even using ready-made steam issuing from the ground at Larderello.

At the London Conference the human aspect of the power problem was also stressed. The engineers present made their inventories with a breadth of view that took into its compass far more than the material units under discussion. The note of the general welfare and the common good was struck again and again, and the purpose of the whole conference

seemed to be to save man power by harnessing every source of power in man's service. And so the stores of energy possessed by each country were counted as national assets in their potential aid to the workers of the world in producing the necessities and comforts of life. In the words of the foreword to *Economic Geography*, these power resources are "decisive factors in limiting the activities of men."

WIND POWER

One type of power seemingly possessed in common by all continents and all countries is wind power. Yet the utilization of this power has varied widely in time and place. As was pointed out



FIGURE 2.—The windmills of Holland. The rise of the Dutch Republic was due to its utilization of wind power, both on land and sea; but British coal drove the Dutch ships from the sea, and usurped to British factories the dominance in world industry. "Wind power can seldom compete with power obtained from heat."

by Professor Van Iterson at the London Conference, the rise of the Dutch Republic was due to its predominance in the use of wind energy. On land and sea Dutch industry and commerce were dependent on wind power, and by this means Holland remained prosperous until after the Napoleonic wars, when

British coal shifted the balance of power in industry and commerce. With its experience of centuries Holland would seem best qualified to speak on the economics of wind power, and Professor Van Iterson sums up this experience: "Wind power can seldom compete with power obtained from heat." Even in raising water, the most appropriate application of the force of the wind, this source of power is so unreliable that a mill delivers in a whole year no more water than it would be able to deliver in sixty days with a good "mill wind." The Dutch windmills were put out of business by the eight-hour regulation of labor, which does not synchronize with the intermittent wind, and even the improved "American" type of wind motor has not been able to overcome this handicap.

The experience of Holland with wind power is not essentially different from our experience here in the United States. Even on the American farms the number of windmills installed during the last census period was only about 26,000, a

negligible item in the marvelous power growth of the United States.

WATER POWER

The water-power atlas issued by the United States Geological Survey in 1921¹ presents maps showing the distribution of the world's water-power resources and gives concise descriptions and tables to supplement the maps. The engineer-authors of this atlas state that their estimates of potential water power are unsatisfactory, even for the United States and Canada, for which exact information was not available, yet the figures they give express orders of magnitude and thus have considerable value to the geographer. The outstanding fact is that more than 40 per cent of the potential water power of the world is in Africa, a plateau continent which in its tropical portion has a heavy rainfall. Asia's share, despite its vast area and its great mountain masses, because of light precipitation barely exceeds that of any of the other three continents. North America, which ranks third in potential water power, leads in its utilization, having 47 per cent of the developed water power of the world. These statistics are obtained from a revised estimate recently issued as a press statement² by the United States Department of the Interior, in which the Geological Survey brings its figures up to the end of 1923. The preceding three-year period of active development showed a world increase of 26 per cent, and in this increase Europe has had a far greater share than the United States, an advance plainly stimulated by the post-war prices of coal. For the first time the United States is lagging behind the rest of the world in developing its water powers.

The following recapitulation is taken from the press statement of March 31, 1925, and Figure 6 shows the contrast between developed and potential power,

¹ *World Atlas of Commercial Geology*, Part II. "Water Power of the World."

² Released to the press March 31, 1925.



FIGURE 3.—An American wind power unit on a Texan farm. Even though the windmill will not synchronize with the eight-hour regulation of labor, it lends itself readily to raising water from wells, both for irrigation and domestic purposes on the farm. The tower rises above the mesquite of Texas as it does above the blue-stem of Kansas or Illinois. (Courtesy of the Axtell Co., Fort Worth, Texas.)

with the continental distribution of each. The real contrast, however, between the developed and the potential power is much greater than that indicated, for owing to the well-established practice of installing wheels sufficient to utilize a flow materially greater than that of the ordinary low-water stage of the stream the present installed capacity may mean not that 6 per cent but probably only 3 per cent of the total potential water

power is thus utilized; moreover, by providing storage the ultimate potential total can be further augmented.

	Horse Power	
	<i>Developed</i>	<i>Potential</i>
North America.....	13,700,000	66,000,000
South America.....	675,000	54,000,000
Europe.....	12,300,000	57,000,000
Asia.....	2,000,000	69,000,000
Africa.....	14,000	190,000,000
Oceanica.....	220,000	17,000,000
Approximate total	29,000,000	453,000,000



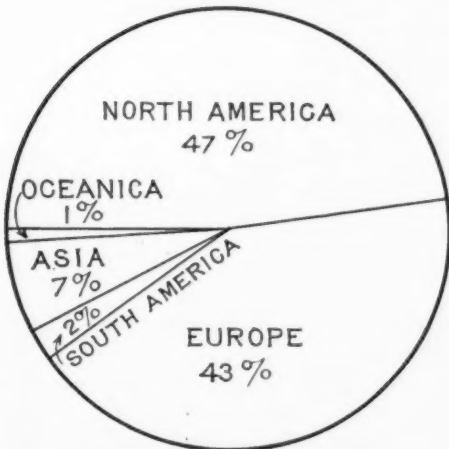
FIGURE 4.—The Great Falls of the Missouri River in Montana, before they were harnessed for power. The center of maximum potential waterpower is in the middle of Wyoming, not far from Casper, but the greatest concentration is perhaps along our northwest coast with its high relief and heavy rainfall. (Courtesy of the U. S. Geological Survey.)



FIGURE 5.—The Great Falls of the Missouri River in Montana after their diversion for power and irrigation. Only under the most favorable physical and economic conditions can great irrigation projects pay out, but when combined with power development like this they may yield enough returns from sale of power to reduce materially the heavy burden of cost upon the land. Power and food production combined are a happy utilization of this natural resource. (Courtesy of the U. S. Geological Survey.)

DEVELOPED

POTENTIAL



WATER POWER OF THE WORLD

FIGURE 6.—Even with its high industrialization the continent of Europe has not yet developed as large a part of its power as has North America, and the other continents have barely begun utilizing theirs. In the future utilization of the potential water powers of the world the great undeveloped energy of Africa may be transmitted into Europe to keep the wheels and furnaces and spindles going when the coal shall all be gone.

COAL RESERVES

In his thoughtful review, at the London Conference, of the coal reserves

of the world, Sir Richard Redmayne accepted the geologists' estimate presented at the Toronto International

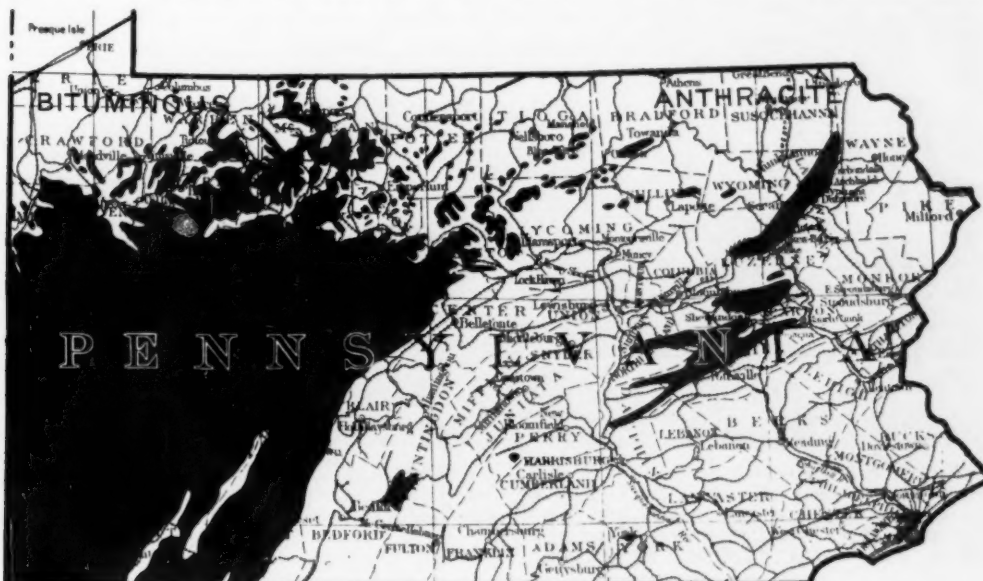


FIGURE 7.—The "Keystone" of America's coal supply, Pennsylvania with its great anthracite fields in the eastern part of the state, and its great bituminous fields in the western half. North America has 68 per cent of the world's potential supply of coal; the United States over 50 per cent. The coal reserves of the United States will probably outlast those of all other industrial countries. (Courtesy of the U. S. Geological Survey.)

Congress in 1913 and considered the distribution of coal in its relation to modern material civilization. Of the grand total of about $7\frac{1}{4}$ trillion gross tons North America has $68\frac{1}{2}$ per cent, Asia 17 per cent, Europe $10\frac{1}{2}$ per cent, Oceanica $2\frac{1}{2}$ per cent, Africa and South America less than 1 per cent each. The United States easily leads all the other countries, with more than half of the world's total. Even the marked increase in the output of coal in this country—33 per cent of the world's output in 1910, 38 per cent in 1913, 46 per cent in 1920—has not yet carried our contribu-

PETROLEUM RESOURCES

The world distribution of petroleum resources can not be set forth in more than the simplest outlines. The search for oil has penetrated even the frontier countries and within the last decade or so has added greatly to our geologic knowledge of hitherto little known regions, but forecasts as to either the location or the extent of undeveloped reserves of petroleum must be regarded as estimates of widely varying probability or finality. Yet such generalized conclusions as have been presented by Stebinger and White³ may serve to

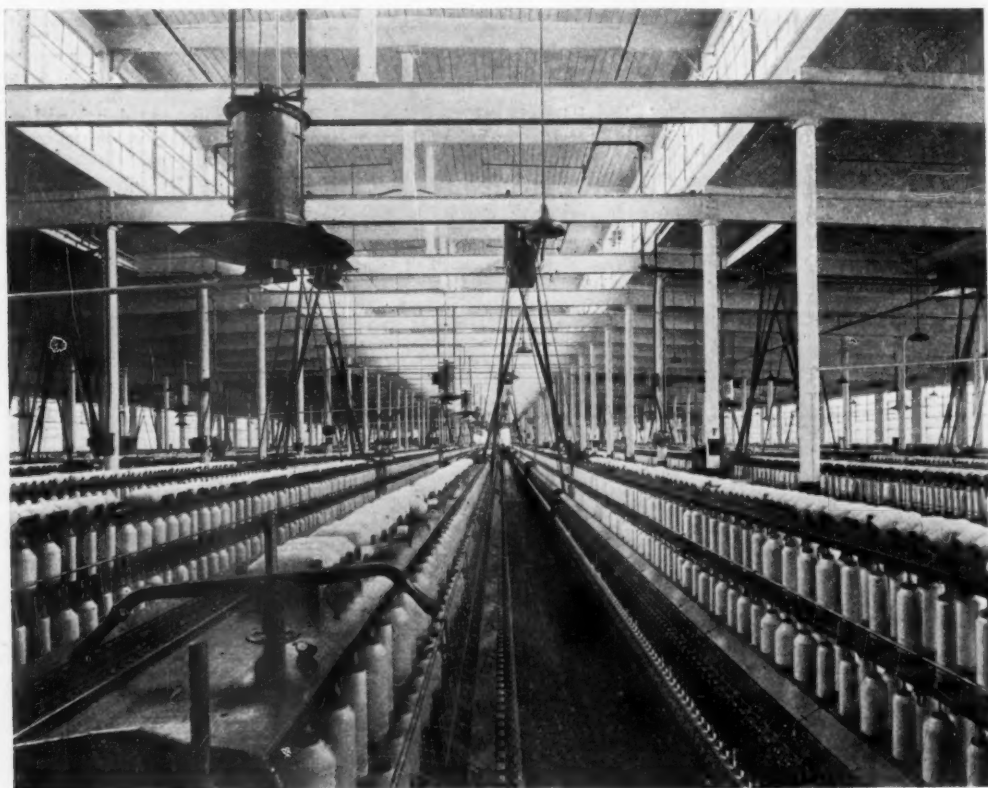


FIGURE 8.—The spinning room of a great textile mill where power not only makes the wheels go round but spins the thread and weaves the cloth that helps to clothe a nation. The textile center of America is shifting southwestward but New England retains a premier position in the industry. (Courtesy of the Saco-Lowell Shops, Boston, Mass.)

tion beyond the ratio of coal reserves to our credit, so Sir Richard predicts that the supply of the United States will outlast that of all other industrial countries.

picture to the student of economic geography both the broad distribution of

³White, David, "Petroleum Resources of the World," *Am. Acad. Political and Soc. Science, Annals*, Vol. 89, p. 122, May, 1920.



FIGURE 9.—A midcontinent oil pool, whence comes part of the gasoline for our automobiles, and lubricants for all kinds of machinery. Nearly 290,000 such wells in the United States, some with larger production, some with less, but all averaging $6\frac{1}{2}$ barrels of crude petroleum a day, yield the power and lubricant that come from oil. In an industrial age, an age of machinery, lubricant is as significant, though not so important, as power. Whence will come our lubricant when our petroleum reserves are exhausted a few decades hence? (Courtesy of the U. S. Geological Survey.)

these reserves and their order of magnitude as compared with those of coal. Such estimates of the unmined petroleum resources of the world, though avowedly subject to discount, correction, and amendment, possess practical value in guiding business action and national policy. The Stebinger-White estimates are probably correct to a degree that warrants us in accepting them as a basis for setting down the continents in order of wealth in oil as North America, Asia, South America, Europe, Oceanica, and Africa. Mr. Stebinger's basal estimates included what might be termed developed regions, with a total of 43 billion barrels of oil "in sight," to speak optimistically. To this figure Mr. White added 20 billion barrels of additional reserves which favorable geologic conditions indicate as probably available. The resulting estimate of the world's total recoverable petroleum is, in round numbers, 60 billion barrels, of which more than one-tenth is credited to the

United States and not quite one-fourth to North America—the continent which, it should be remembered, is now producing more than four-fifths of the world's output.

THE POSITION OF THE UNITED STATES

The extent to which Nature favors the United States in the distribution of energy may be summarized by graphic presentation. Figure 11 shows our country's share of coal, water power, and oil as compared with the estimated totals for the rest of the world.

The United States is preëminently the most generous user of mechanical energy in the world. Before summarizing this country's position in its possession of the principal sources of energy—water, coal, and oil—it will be enlightening to obtain a general idea of the magnitude of the present drafts upon our supply, as well as the relative demands made upon these three principal sources.

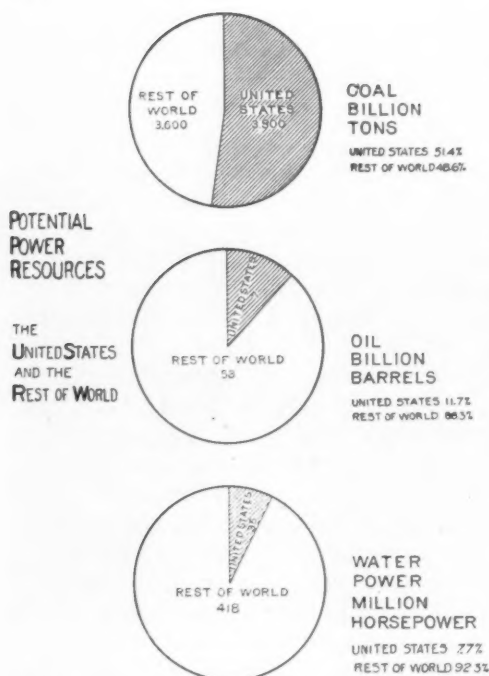


FIGURE 10.—Our country's share of coal, water power, and oil as compared with the estimated totals for the rest of the world; as long as our coal reserves last, a score of centuries or more probably, our industries will not lack cheap power, and our factories can successfully compete with those of other lands for the markets of the world.

Tryon and Mann,⁴ in estimating the current consumption of energy in the United States, place the total at more than 25,000 trillion British thermal units and show that of this total the mineral fuels supply 87 per cent—coal 65 per cent, oil 18 per cent, natural gas 4 per cent. Water power supplies only 4 per cent, work animals 3 per cent, and the wind less than one-tenth of 1 per cent. Inasmuch as the total includes heat energy as well as mechanical energy, firewood is credited with 6 per cent, so that even in these days the forest still yields more energy than wind and water combined; but the mineral fuels now furnish more than six times as much energy as all these others with work animals added. This increasing depend-

ence on mineral fuels is further emphasized by the facts that as late as 1880 they were subordinate to firewood and that prior to 1850 they furnished less energy than even the work animals.

As the world's largest users of mechanical energy, and indeed of most of the products of mines, smelters, mills, and factories, we need to study every available inventory that can be made of the power resources of the United States, especially in comparison with similar resources of other industrial peoples. In making this comparison we may conveniently state our national reserves of energy in terms of present population, thus translating the statistics of our material resources into per capita units.

The potential water power of the United States, only a small part of which is developed, is less than 1 horsepower per person, an allotment far below that of the peoples of Norway, Canada, and Sweden; even Switzerland has twice as large a per capita wealth in water power. The developed water power credited to the United States, though at first it seems large, becomes insignificant when it is reduced to per capita units, being less than one-tenth of 1 horsepower, far below the third of 1 horsepower per capita of Switzerland or Canada and the seven-tenths of Norway.

In per capita reserves of coal the United States possesses more than 23,000 tons, not including lignite, for every man, woman, and child of the present population. Other industrial nations rank about as follows: Great Britain has about 5,000 tons per capita, Germany probably still owns not less than 4,000 tons, Belgium perhaps 1,500 tons, France probably more than 800 tons, Spain less than 400 tons, and Japan 150 tons.

We can not state our per capita reserve of petroleum with so much assurance of quantitative accuracy as we can state reserves of coal or water, yet the best estimate available shows that considered as a future source of energy petroleum occupies a status far different from that

⁴ Tryon, F. G., and Mann, Lida, "Mineral Resources for Future Populations," *Journal American Statistical Association*, December, 1924.

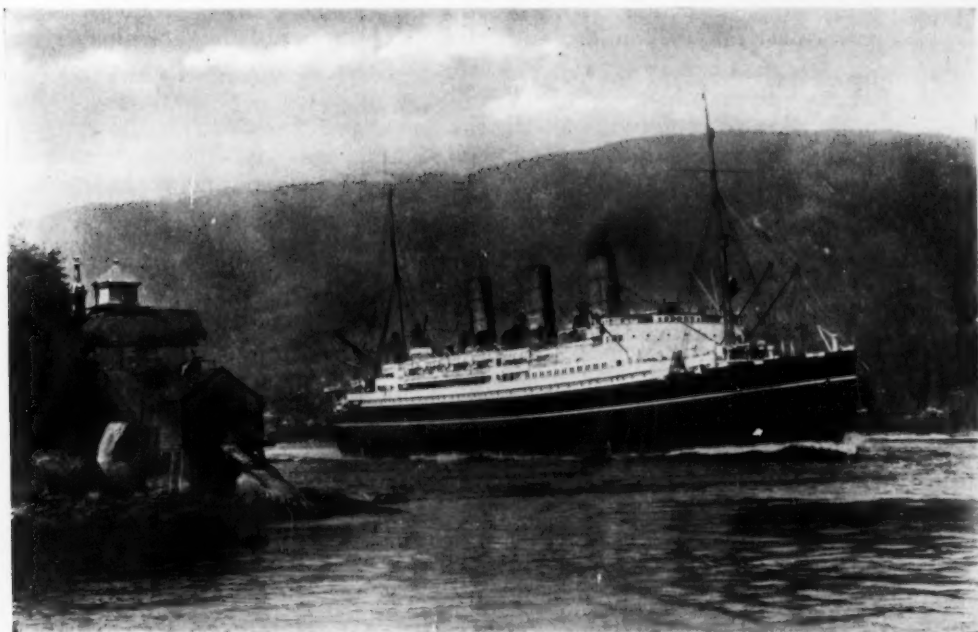


FIGURE 11.—Where oil and water power meet—a great oil-burning steamer passes a modest little mill moved by water.

of coal. The share of each man, woman, and child in the unmined petroleum recoverable under present conditions and by present methods is probably less than 100 barrels, and the present annual production is a little over 6 barrels. These simple figures are full of significance. We undoubtedly have more oil than any other industrial nation, but certainly far from enough.

DISTRIBUTION WITHIN THE UNITED STATES

With this picture of the world distribution of energy resources in mind we can glance at the map of the United States and consider the facts of distribution within our own country, which we do well to keep in mind is continent-wide.

The center of energy for the United States may be determined in terms either of present production or of potential supply. Considering first the centers of gravity for the three main sources of energy, we may note that these centers are located in what most people in the United States would term the "Far

West." The center of maximum potential water power is in the middle of Wyoming, about 35 miles southwest of Casper. The center of the original tonnage of coal in the United States is similarly determined as about at the crossing of 41° north latitude and 99° west longitude, or 30 miles west of Grand Island, Nebraska. In this determination the lignite regions were not included, nor the coal that lies at greater depth than 3,000 feet. The center of the remaining petroleum resources, as estimated by the oil geologists, is on the New Mexico-Colorado line, northeast of Raton.

It is not practicable to reduce these energy resources—water, coal, and oil,—to common units of weight and to fix a common center of gravity for all the potential power awaiting the use of future generations, but a glance at the map suggests the northeast corner of Colorado as the region that is nearest central for the coal fields, the oil pools, and the water powers of the United States. It is interesting to note that

western Colorado is the center of the oil shale deposits of Utah, Wyoming, and Colorado, a reserve of energy far exceeding in quantity the petroleum resources that are now being so rapidly depleted.

The mention of future demand for power naturally leads to the determination of the present centers of production and the trend of the demand as indicated by comparison of these with earlier determinations. In 1924 the approximate center of coal production was in Madison County, Ohio, about 30 miles southwest of Columbus. In 1918 the corresponding center was some 50 miles farther north and west. The center of oil production is now in northeastern New Mexico, about 40 miles southeast of Raton; in 1918 it was near the Kansas-Colorado line, somewhat more than 150 miles to the northeast. The center of electric-power generation in the United States in 1924 was in Illinois, 50 miles southwest of Chicago, and the shift of this center since 1920 was somewhat west of south and amounted to less than 20 miles. Another interesting element of the geographic distribution of the

demand for petroleum products is the center of automobile registration, which in 1924 was in Illinois, close to Peoria. The automobile thus leads population in its westward course, for the center of population, as last reported, was in Indiana, 50 miles southwest of Indianapolis. Indeed, the recent trend of all three centers has been to the west and south, with the exception of that for coal production, which in the past year or two has felt the pull of West Virginia's marked increase of output from nonunion mines.

THE BATTLE FRONT OF POWER

Franklin K. Lane, in writing of the complexity of the task of developing all our available power for the purpose of making America the home of the cheapest, the most abundant, and the most serviceable power in the world, said, "There are few who know even one sector of the great battle front of power." The fuller knowledge of the distribution of the supply of energy with which this country is blessed is an essential part of economic geography.

THE DISTRIBUTION OF DOMESTIC ANIMALS

Ellsworth Huntington

Climatologist, Yale University

THE value of the chief animal products of the world, when reckoned in American prices, is approximately 27 billion dollars per year. This is about half the value of all the vegetable products raised for all purposes except food for animals; it is twice the value of all the minerals. The total number of species which furnish this vast value is only about 50, even if we include such animals as the elephant which is rarely or never bred in captivity, the white rat, the mongoose, the ferret, the falcon, and the

one-humped Arabian camel, two-humped Bactrian camel, llama, and alpaca; in the Deer family, reindeer. These 16 are all ungulates or hoofed mammals. The only other mammals are the dog, the cat, and the rabbit. Among birds the hen, the turkey, the guinea fowl, and the peafowl, belong to one order; the duck, the goose, and the swan to another; the pigeon to a third; and the ostrich to a fourth. The only other important domestic animals are two insects, the silk-worm and the bee.



FIGURE 1.—A pack train in the mountains of southwestern Colorado. The horse is adapted not only to working in harness pulling vehicles and farm implements of various kinds, but also to use as a beast of burden. This latter use is especially important in undeveloped or mountainous regions. (Photo by W. W. Atwood.)

cormorant, and credit the bee with several species. The animals that are really important number 30: namely, in the Horse family, the horse (Fig. 1) and ass; in the Cattle family, European cattle, humped zebra or Brahman cattle of India, gayal, banteng, yak, and water buffalo; in the Pig family, swine; in the Camel family,

THE LIMITATIONS OF DOMESTICATION

Several important facts deserve notice in connection with these 30 animals. (1) Every one of them was domesticated so long ago that we have no certain knowledge of the event, and in many cases not even a tradition. (2) The number of species that have proved permanently

worthy of domestication is extremely small. Approximately 3,500 species of mammals are known, but only 19 belong to the 30 listed above. Of the 13,000 species of birds, only 9 fall among our 30 animals, and one of them, the ostrich, may drop out, if its feathers fail to continue in favor. The reptiles with 3,500 species, the amphibians with 1,400, and the fish with 13,000, have no domesticated representatives. The case of insects is

members of the camel family have been domesticated, and two of the seven members of the horse family. All the more important birds come from two orders, *Galliformes*, and *Anseriformes*.

USES OF DOMESTIC ANIMALS

Usefulness is the chief quality which makes an animal worth domesticating. In a stage of culture like ours the main uses of domestic animals are: (1) food,



FIGURE 2.—Ploughing on the plains of western Canada. No animal equals the horse for farm work in humid or even semi-arid temperate climates. The horse is intelligent, docile, strong and possesses great endurance. Eight horses are shown in the picture plowing three furrows at once. (Courtesy of National Resources Intelligence Service, Ottawa, Canada.)

still more extreme, for silkworms and bees are the only domesticated species among approximately 470,000. (3) The qualities which make an animal worth domesticating are concentrated in a few small groups. Among the 30 animals here discussed no less than 16 belong to a single group, the *Ungulata* or hoofed mammals. Six of these are species of cattle, all from the same genus, which contains only 10 species in all. The Cattle family, as distinguished from the genus, also includes the sheep and goat, so that one fourth of the important domestic animals comes from this one family. In the same way four of six

(2) transportation, (3) clothing, (4) raw materials for uses other than clothing, (5) protection, (6) hunting, (7) scavenging, (8) fertilizer. Food is put first because financially it occupies the primary place. When reckoned at American prices, the principal food products derived from animals are worth nearly 23 billion dollars per year, or more than half as much as all the vegetable food consumed by man (41 billion dollars' worth). The annual production of animals for transportation all over the world has an estimated value of about two billion dollars, but the relative importance of animals in this respect is prob-

ably much greater than this. The wool, silk, and hides supplied by animals each year give the clothing materials a similar value in dollars, although their importance is probably much less, as will appear below. The other five uses occupy such minor rank that they are not considered.

THE IMPORTANCE OF ANIMALS FOR TRANSPORTATION

The use of animals for transportation and draft is probably more important

the realization of a high standard of living. Without draft animals, mankind might never have grasped the wonderful possibilities of the wheel, without which modern machinery might never have developed (Fig. 5). The desire to utilize horses or other animals more fully for draft purposes presumably led primitive man to put wheels under his sledges, and later to gear wheels together so that his animals might grind grain, pump water, and the like. Thus in many ways beasts of burden and draft animals have



FIGURE 3.—Ploughing near the Pyramids in Egypt with a buffalo and a bullock. These animals are slow, less strong than the horse, and the primitive plow scarcely more than scratches the ground; but they can endure both heat and moisture, and they work well in the deep mud of rice fields. In buffalo-raising countries the people are poor, and the cattle provide milk and meat as well as power. (Courtesy of Ginn and Co., Boston.)

than for food (Fig. 4). Without beasts of burden, human beings might still be carrying all loads on their backs or heads, as do the highland Indians of Guatemala, for example. If animals had not been trained to draw the plow, the great centers of agriculture and civilization might never have migrated into those regions of forest and prairie where the climate is especially stimulating and the highest civilizations now center (Fig. 2). Fields can be spaded by hand, but the labor is so great that it almost precludes

been essential in the evolution of the highest types of civilization (Fig. 3).

The introduction of motor transportation is sometimes supposed to have eliminated the horse as a necessity. This is not true. Motor traction except on large level farms is too expensive for most farmers. The United States has five of every six of the world's motor vehicles, and a still larger percentage of the farm tractors. The 1,700 million people, more or less, in other countries, still depend almost entirely upon horses, donkeys,



FIGURE 4.—An Eskimo on Smith Sound, Greenland, moving all his possessions to a better hunting ground. On the far Arctic frontier where the Polar Eskimo of Northwest Greenland, the northernmost people on the globe, maintain their settlements almost a thousand miles beyond the Arctic Circle, the only domesticated animal is the dog. Intelligent, strong of bone and sinew, tolerant of cold and hunger and hardship, loyal and faithful in times of stress and starvation, he is as essential to the existence of the Eskimo as game itself. He is the only draft animal adapted to an exclusively carnivorous diet, to travel on land or on sea-ice, to a hunting culture, and to the vicissitudes of an intermittent food supply. If wealth or prosperity can be measured among the Polar Eskimo it is in terms of number and condition of dogs. (Courtesy of American Museum of Natural History. Photo by D. B. MacMillan.)

mules, cattle, and even camels for plowing and other farm work. In the United States, to be sure, the number of horses, mules, and asses in cities and villages, diminished from 3,470,000 in 1910 to 2,100,000 in 1920, and has fallen still lower in 1925. Moreover, although the horses, mules, and asses in the entire United States, including both farms and towns, increased from 24,150,000 in 1910 to 25,270,000 in 1920, there was a decrease from 1917 to 1925. The birth rate fell from 90 colts per thousand horses and mules in 1919 to only 44 in 1924. Nevertheless, the congestion of traffic in cities, the consequent slowness of trucks, and the high cost of fuel and maintenance are bringing the horse back in some places, and the decline in the birth rate of colts seems to be near its end. Thus the effect of motor transport in diminishing the number of horses in the United States appears almost to have reached its limit.

On January 1, 1925, there still remained approximately 24,500,000 horses and mules in the United States.

If these animals, and all other draft



FIGURE 5.—The Dog Express at White Horse, Yukon Territory, Canada. For travel in the Arctic the dog becomes invaluable. He can live on meat, which is more abundant in the far north than vegetable feed, and is intelligent, speedy, docile and loyal. W. C. Mendenhall, Courtesy of U. S. Geological Survey.)

animals such as oxen, should suddenly be taken away, mankind would probably be in a far worse state than if all animal food were eliminated. On the majority of farms, even in the United States, the removal of the draft animals would reduce the production of food so drastically that the farmers could scarcely feed their own families. Even those who could spade up enough land to produce a surplus, could only with difficulty get their products to market. Prices would skyrocket; the three fourths of the people of the United States who live by other means than farming would be in dire straits; famine would ensue; and multitudes would perish. The construction of more tractors and automobiles would not solve the difficulty, for a vast number of farms are too small, too rough, or otherwise unfitted for cultivation by machinery. Moreover, the increased demand for motors and gasoline would send prices far beyond the reach of the impoverished farmers. The loss of all our beasts of burden might reduce even so rich a country as the United States to a scale of living approximating that of China (Fig. 6).

THE DISTRIBUTION OF DOMESTIC ANIMALS

Before discussing the individual species of domestic animals, let us consider the distribution of all species taken together. This obliges us to determine the relative importance of the different animals. How many hens or sheep, for example, are equivalent to a horse or a cow? The United States Department of Agriculture uses a standard based on the amount of food consumed per animal, by which a horse, a cow, or an ox is considered an animal unit equivalent to five swine, seven sheep, or 100 hens. For our purposes, a standard based on values is preferable, for the price at which an animal sells is the best available measure of its general usefulness. On the basis of the United States censuses of 1910 and 1920, together with



FIGURE 6.—Camels coming into Peking bringing products from the deserts of Mongolia. Where the climate is very dry the camel replaces the ass, because he is speedier, can carry larger loads, and can go long distances without water. (Courtesy of Ginn and Co., Boston.)

data from other countries, the relative values are approximately as follows:

Poultry.....	0.1	Llamas.....	1.5
Goats.....	0.5	Asses.....	1.5
Reindeer.....	1.0	Cattle.....	5.0
Dogs (for work).....	1.0	Horses.....	12.5
Sheep.....	1.0	Mules.....	17.5
Swine.....	1.5	Camels.....	20.0

As used here, an animal unit happens to correspond to the value of a sheep, work dog, or reindeer; we might equally well use a unit one tenth as large and equivalent to a hen, or five times as large and equivalent to a cow. By adding together the relative values of all the animals in each country or state, we obtain the total animal units and from this determine the units per capita of the human population and per square mile (Figs. 7 and 8).

THE RELATION OF DENSITY OF POPULATION TO NUMBERS OF ANIMALS

A comparison of the map of animal units per square mile with that of animal units per capita reveals the striking and

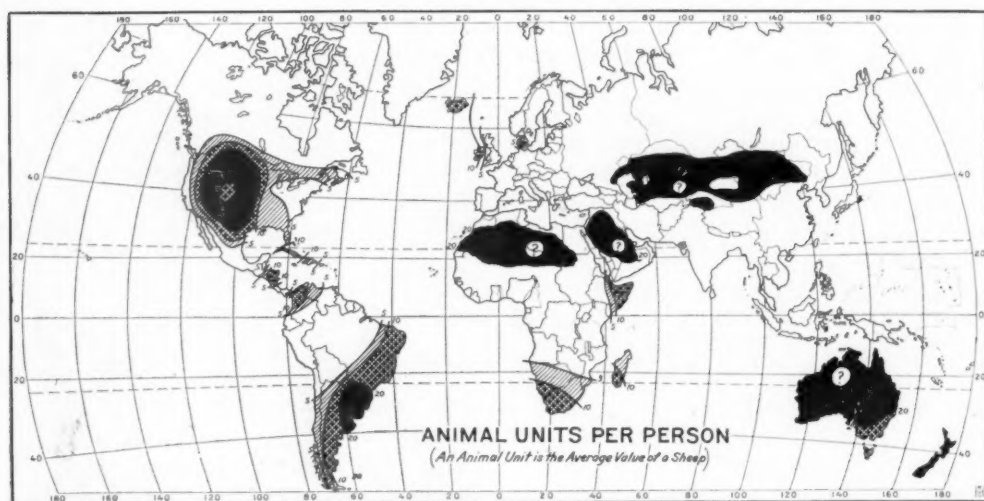


FIGURE 7.—The per capita distribution of domestic animals, according to the same unit as in Figure 8, follows the equally definite law that regions with few inhabitants per square mile tend to have many animals per capita. Comparing this map with Figure 8, one finds that the regions of high density per capita distribution are generally regions of low density per unit-area.

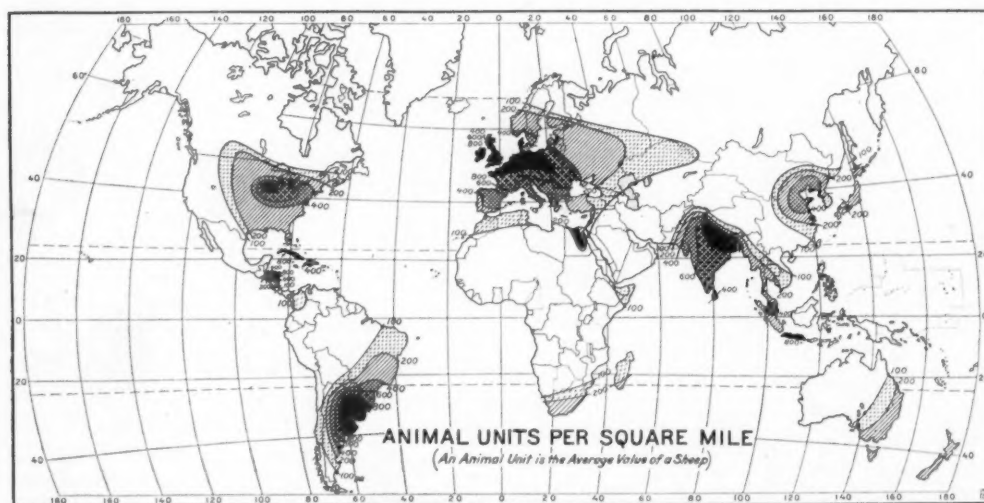


FIGURE 8.—The areal distribution of domestic animals, when all types of animals are added together on the basis of their relative value, follows the very definite law that regions with many inhabitants per square mile tend to have many animals per square mile. A comparison of this map with Figure 7 reveals the striking and significant fact that a high animal-density per unit-area corresponds with low density per capita.

significant fact that where animals are many per capita, they are generally few per square mile, and vice versa. To be sure, this generalization is often obscured by other factors such as climate, stage of civilization, the relief of the land, diseases, and the location of markets. Its general truth, however, is well illustrated

in Fig. 9. The dotted lines show the number of animals per capita according to the scale on the right, and the solid lines the number per square mile according to the scale on the left. The various states or countries are arranged according to the density of their population per square mile, the most densely populated

ANIMAL UNITS PER SQUARE MILE AND PER PERSON COMPARED WITH DENSITY OF POPULATION PER SQUARE MILE

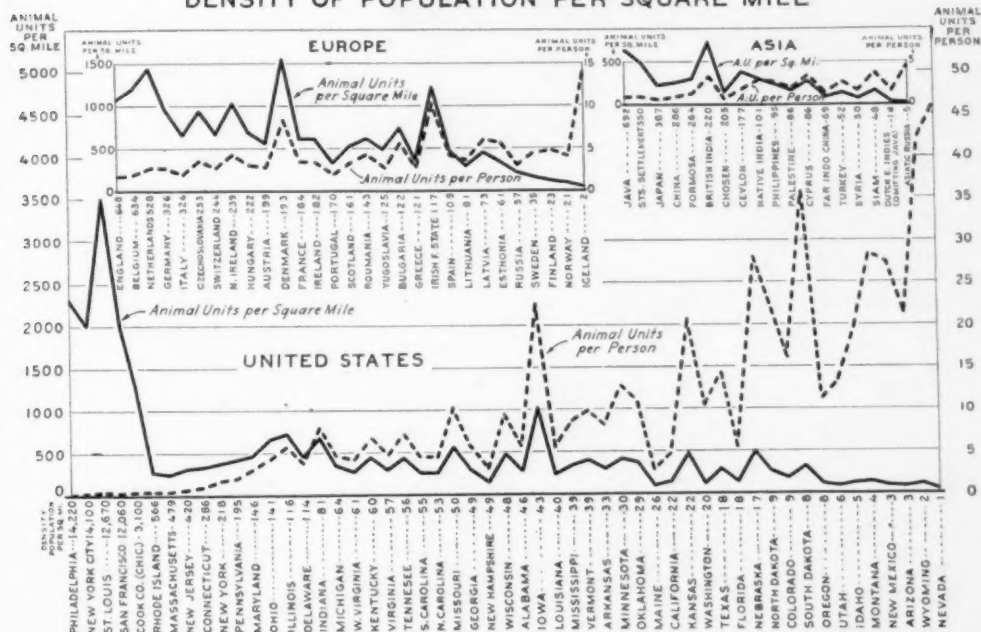


FIGURE 9.—In each section the two lines rise and fall together in their minor fluctuations, but the dotted lines shows a general tendency to rise from left to right, while the solid line shows a similar tendency to fall. The general tendency for the two lines to move in opposite directions is consequent upon the relation between the density of animals, and the number of animals in proportion to the number of people.

being on the left and those sparsely populated on the right. In each section of Fig. 9, the two lines rise and fall together in their minor fluctuations, but the dotted line shows a general tendency to rise from left to right, while the solid line shows a similar tendency to fall. The minor irregularities are due to the other factors mentioned above. The general tendency for the two lines to move in opposite directions is due to a fundamental mathematical relationship between three factors: (1) the density of the human population, (2) the density of the animal population, and therefore (3) the number of animals in proportion to the people. The same tendency appears in similar diagrams for each continent, and even in diagrams where states like those of the United States, Canada, and Australia are represented. This indicates that all over the world, the places which have many inhabitants per

square mile tend to have many animals per square mile, and few per capita. The opposite is equally true, for regions with few inhabitants per square mile tend to have few animals per square mile, and many per capita.

This relationship is revealed with notable clarity in Europe. England and Wales, with a density of 648 people per square mile (as shown by the figures following the word *England*), Belgium with 634 per square mile, and Netherlands with 528, have a great many animal units per square mile, namely 1070, 1202, and 1438 respectively. At the other end of the scale, Finland and Wales have only 1.7 animal units per capita, Belgium 1.9 and Netherlands 2.7, whereas Finland has 4.0, Norway 4.3, and Iceland 14.2.

The curve for the United States in Fig. 9, although more irregular than that of Europe tends to prove the same thing.

One of its most extraordinary features is the great height of the solid line at the left where five large cities are shown. In large cities animals are relatively inconspicuous because of the great numbers of people and automobiles. Nevertheless, in proportion to their area, cities generally contain far more animals, especially horses, than do adjacent rural areas. Another notable feature of the United States' curve is the high general level of the dotted line. This means many animals per capita and is a rough indication of the generally high standard

able estimates, has a density of 286 per square mile for its human population, and 246 animal units for its animal population. The corresponding figures for Japan are 387 for people and 206 for animals. On the other hand, the number of animal units per person is low, as might be expected, being 0.9 for China and 0.5 for Japan, but both of these are higher than Massachusetts, 0.4.

VALUE FOR TRANSPORTATION AND DRAFT

The distribution of individual species of domestic animals depends very largely

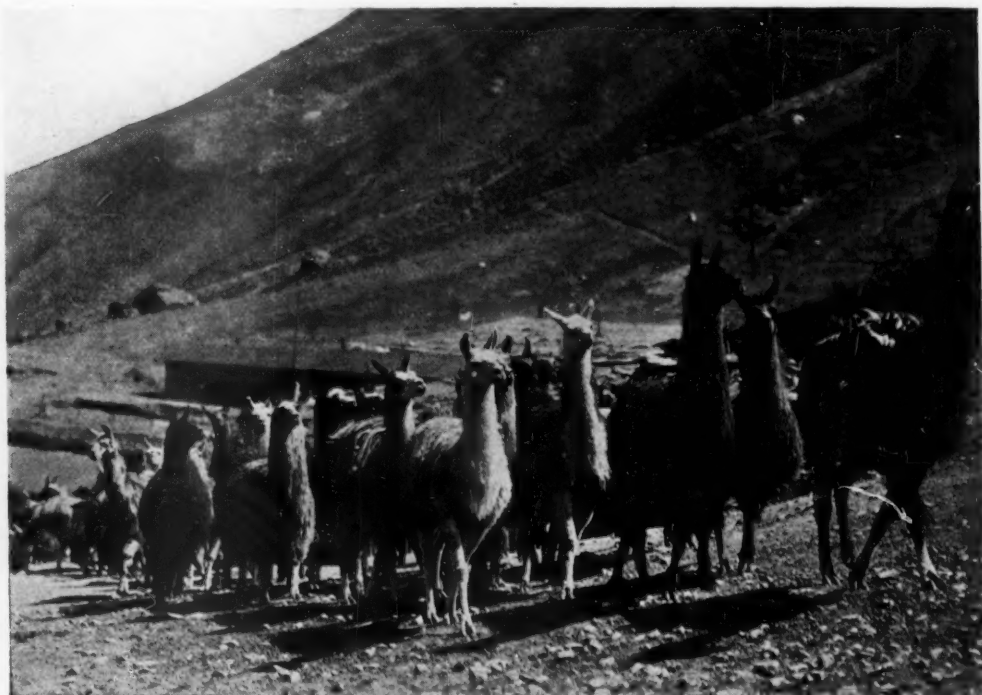


FIGURE 10.—A llama pack train on the plateau of Peru. Where the altitudes are great and the air is rare the llama replaces the horse as a beast of burden. But it will be noted that even the llamas are lightly loaded. (Photo copyrighted by Brown and Dawson, New York City.)

of living arising from the newness of America, the energy of its people, and the great natural resources.

Contrary to the common belief that the dense human population of China and Japan leaves little room for animals, the third curve in Fig. 9 shows that Asia follows the preceding generalization quite as closely as Europe and the United States. China proper, according to the best avail-

on their usefulness. From the standpoint of transportation and farm work, the ideal animal possesses the following qualities: (1) Intelligence; in this respect the dog, the horse, the donkey, and the elephant rank specially high; cattle, reindeer, and camels are moderately good; and llamas (Fig. 10), sheep, goats, and pigs relatively poor. (2) Sufficient size and strength to carry one man long distances

easily. The horse, the ass, all six members of the cattle family, the reindeer, the camel, the llama, and the elephant satisfy this requirement fairly well. That is one reason why they have been domesticated. The camel, however, is too large, for he can easily carry two or three people, and the elephant is still larger. Such large animals do not pay, for a man needs to ride alone far more often than with one or more companions. To feed and care for a big animal when a smaller one will suffice is like paying a man to do a boy's work. The donkey, the reindeer, and the llama, on the other hand, are too small. They can carry a man, to be

wheeled vehicles, and draw the plow through sod. Here again the horse is probably the best of all animals, but cattle are also excellent. The donkey would be almost equally good, but it is not heavy enough. The camel, the llama, and the elephant lack the hard hoofs which are essential for the good draft animal.

On the basis of the criteria mentioned above, the horse stands far ahead of all other animals so far as transportation and farm work are concerned. Cattle, donkeys, and camels rank fairly well. Reindeer, elephants, and llamas are also useful. The dog, the sheep, the goat, the



FIGURE 11.—A reindeer herd of about 500 head climbing the trail above Iliamna, Alaska. On the tundra of the far north, where the Arctic pastures consist mostly of mosses and dwarf willows, and the winter nights are long, neither horses nor cattle can be raised. So man has tamed the reindeer. (Courtesy of U. S. Forest Service.)

sure, but not easily for long distances, especially if he has baggage. Horses and cattle are almost exactly the right size. (3) Fairly good speed, day after day. Here the horse and camel are best. Cattles, donkeys, reindeer (Fig. 11), and elephants are less speedy, or get tired more quickly. The elephants (Fig. 12) have little endurance and can work only a few hours per day. (4) An easy gait. In this respect the horse and the ass are much the best. (5) Ability to draw as well as to carry. As a factor in human progress it is especially necessary to have animals that can pull

pig, and the alpaca are of practical use only when no other animal is available, or under peculiar physical conditions.

RELATIVE VALUE OF ANIMALS AS PRODUCERS OF FOOD

If all animals could be raised with equal ease, their value for food would depend on (1) the quality of the meat, (2) the extent to which they furnish other food products such as milk and eggs, and (3) the rapidity with which the young grow to marketable age.

(1) The quality of the meat is the least important of these three factors.

Excepting the dog, the cat, the silk-worm and the bee all the domesticated animals mentioned above furnish excellent meat. Differences in the quality of the meat, although important, are generally minor factors in determining where each species shall be raised, unless it be in the case of the rabbit and the pig.

(2) A more important consideration is the extent to which an animal furnishes food products other than meat. All of the 16 ungulates, except the pig, are milked in certain regions, and in all cases the milk is an admirable article of diet. Nevertheless, ordinary cattle, together with goats and sheep, far surpass the other animals in this respect. That

the point of view of food products other than meat, the most desirable animals appear to rank as follows: cattle, hens, goats, sheep. Even the honey bee contributes its share to human sustenance.

(3) As a rule, the more rapidly an animal reaches maturity, the less the expense of producing a given weight of food for man. Young horseflesh is as good as the best beef, but the horse requires nearly four years to reach maturity, an ox only two. The sheep, goat, pig, and the edible domestic birds are still better in this respect, for they attain almost their full size within a year. The pig and the birds have the further advantage of producing many young at one time, and sometimes



FIGURE 12.—In the hot, humid climate of southeastern Asia horses do not thrive, and even asses are not numerous. So elephants are used as beasts of burden, especially for heavy work. The picture, taken in Ceylon, shows an elephant carrying a log. (Courtesy of Ginn and Co., Boston.)

gives them great value; for, aside from rice, milk appears to be the most valuable single product in the whole world. If we reckon all products everywhere at American prices, its value (\$8,800,000) exceeds that of potatoes, hay, wheat, and wood, and amounts to nearly a third of the value of all the animal products produced each year. At a rough estimate, the world's annual production of eggs is worth \$1,800,000,000 when reckoned at American prices, or about as much as oats, or mutton. As a producer of eggs no bird can compare with the hen. From

more than one litter or brood per year. If we disregard the cost of their feed, the best animals probably rank nearly as follows in respect to the amount of meat in proportion to their feed: hens, pigs, sheep, goats, cattle.

RELATIVE VALUE AS PRODUCERS OF CLOTHING

As sources of textiles, no animal, unless it be the alpaca, can compare with the sheep. Wool owes its value partly to the fact that, unlike fur, it can be spun into thread. The world's annual pro-

duction of wool (\$900,000,000), reckoning again at American prices, is worth nearly three times as much as that of silk. The llama, the camel, the reindeer, and the goat come next to the sheep, the silkworm and the alpaca as sources of materials for cloth, for they yield hair which is soft and wooly for clothing. Other domestic animals are of little use for clothing materials other than leather. But the world's annual production of leather is worth nearly 700 million dollars, or about three-fourths as much as the wool. As the best leather comes from cattle and horses, these animals have another claim to high value.

THE WORLD'S MOST VALUABLE ANIMALS

If all domestic animals could live equally well in all environments, which

would be raised in greatest numbers? Quite obviously the horse would almost everywhere be the choice for transportation and draft purposes. Ordinary European cattle would be raised practically everywhere because of their combined efficiency as producers of meat, milk, and hides, and because they are useful for transportation and farm work. No other cattle would be raised, for the other species yield less milk than European cattle, and some, such as the yak and water buffalo, are less tractable. Sheep likewise would be desired rather than goats, but the alpaca might be as popular as the sheep. Pigs would be raised in large numbers because they yield much meat in proportion to their food, and are easily fed. Hens would be in demand for the same

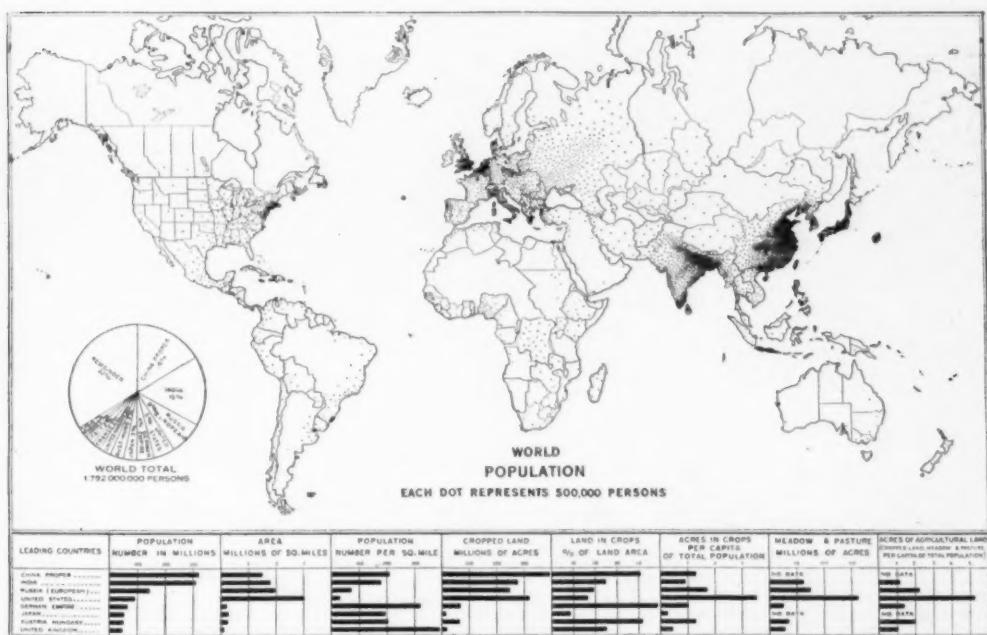


FIGURE 13.—Seven centers of dense population may be noted on the map—Japan, China, Java, India, Italy, northwestern Europe, and the coast of the United States from Boston to Baltimore. Among the nations of the world the greatest density is in England, where there were at the last census 700 people per square mile. The density in Massachusetts is about 480, in Belgium 634, in Germany and Italy about 325, in China Proper nearly 300, in India 175, in Pennsylvania 170, while the average for the United States is 34. Of more significance, however, is the acreage of crops per person, which ranges from about $\frac{1}{3}$ acre in Japan, nearly $\frac{1}{2}$ acre in the United Kingdom, about 1 acre in India, Germany and China, $1\frac{1}{3}$ acres in Russia, $3\frac{1}{2}$ acres in the United States, $4\frac{3}{4}$ acres in Canada to $6\frac{1}{4}$ acres in Argentina. The high standard of living in the United States is due largely to the fact that there are 5 acres of improved land (crop, fallow, and improved pasture) per capita of the population as compared with $2\frac{1}{2}$ acres or less in the other populous countries of the world. (Map and caption from Finch and Baker "Geography of World Agriculture," U. S. Dept. of Agriculture, 1917.)

reasons, and also because they are best producers of eggs. Silkworms and bees occupy unique, though minor places, in supplying human needs, and therefore would presumably be widely raised, even though artificial silk is now becoming common, and vegetable sugar easily obtained. All the others would presumably be raised only as luxuries or for some special purpose.

If all animals could be raised as easily and perfectly in one part of the world as another, the distribution of the animals would be essentially the same as that of man. The actual distribution is very different, for it is influenced by climate, relief, soil, markets, stage of progress, density of population, social, religious and political conditions, and certain other factors; the more significant of these factors in distribution will be considered.

THE DISTRIBUTION OF HORSES

In one important respect, animals like the horse, that are used for transportation, resemble those like the dog and cat, that are used for protection. They are of little use unless they live so close to their owners that they are available all the time. Wool, meat, dairy products and even eggs, if properly prepared may be shipped ten miles, or even ten thousand, and still be almost as useful as if raised in the back yard; but a farmer whose horses live five miles away might almost as well have none. Therefore if horses could live everywhere and be used for all sorts of farm work, we should expect their distribution over the earth's surface to be almost identical with that of man, except that backward and unprogressive people would not keep so many as the more progressive.

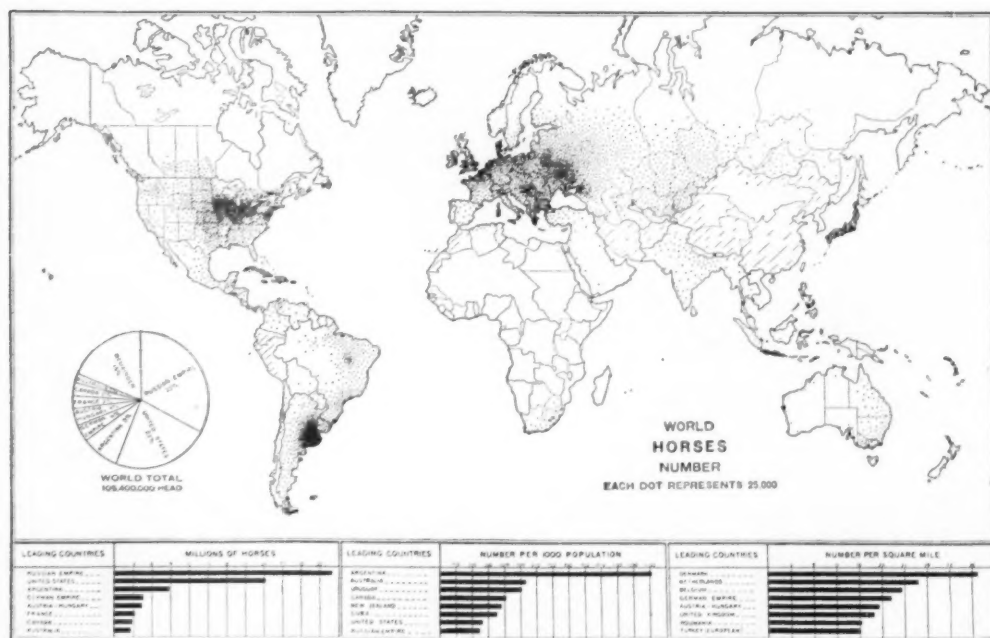


FIGURE 14.—In Europe, and in countries settled by Europeans, horses are most numerous in the best agricultural regions. In these countries the distribution of horses, more than that of any other farm animal, corresponds to the distribution of the human population. Russia and the United States, the largest agricultural nations, lead in actual number of horses. Relative to the population, horses are most numerous in those countries which have extensive agricultural and grazing industries and sparse populations. The number of horses relative to area, however, is greatest in northwestern Europe, where agriculture is highly developed and intensive. In the Orient, where human labor is plentiful and cheap, and cattle are used both in agricultural labor and in transportation, horses are few. (Map and caption from Finch and Baker, "Geography of World Agriculture," U. S. Dept. of Agriculture, 1917.)

A comparison of Figs. 13 and 14 shows that, in a general way, the distribution of horses is like that of people in North America and Europe, the two continents with the best climates and the most progressive type of civilization. The number of horses in proportion to the number of people appears much greater than it really is because each dot represents only 25,000 individuals on the horse map, and 500,000 on the population map. If the number of persons per dot were diminished in South America and increased in Asia, and if the horse map could be completed in China and other countries

In order to appreciate more clearly the factors which determine the distribution of horses, compare Fig. 15 showing all the land in harvested crops in the United States with Fig. 16 showing the distribution of horses. The two are astonishingly alike in the following respects: (1) The concentration of animals in the Corn Belt from Ohio to Iowa; (2) the sparsity of animals in the dry regions of the West, and in the more rugged areas of the East; (3) the local concentration wherever level land, irrigation, and other conditions permit farming in the western half of the country; (4) the belts of rela-

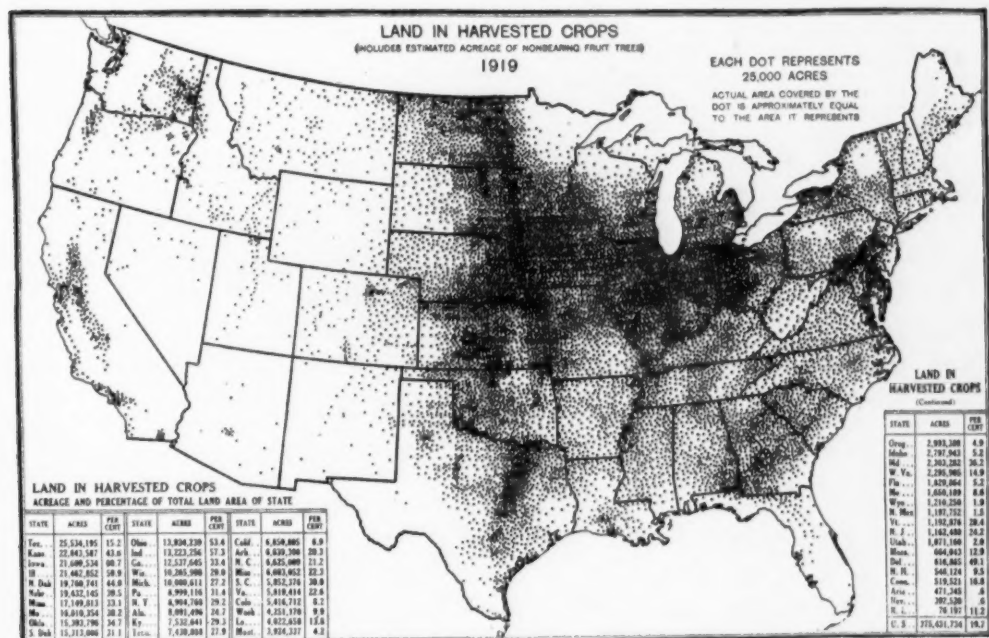


FIGURE 15.—Over five-sixths of the crop land is in the humid eastern half of the United States, and nearly two-thirds is concentrated in the triangular shaped area whose points are Eastern Ohio, Central Texas, and northern North Dakota. In this area, which includes only about one-fourth of the land of the United States, are produced four-fifths of the corn, three-fourths of the wheat and oats, and three-fifths of the hay crop of the nation. The corn, oats and hay are practically all fed to live stock, hence few regions in the world of so large size possess so many animal units per square mile. (Map from 1921 Yearbook, U. S. Dept. of Agriculture.)

where there are no good statistics, the map of horses and people would show many resemblances in those continents also. Only in Africa do the two maps become almost completely different, for there horses are almost absent except in the far north and the south.

tive density extending southward along the fertile Mississippi Valley and farther west in the fertile strip from Kansas to eastern Texas; (5) the general decline southward and eastward where both physical and social conditions are less favorable to the most productive agri-

culture. Note, however, that there are at least two marked differences in the maps. One is the concentration of horses in knots around the eastern cities, and the other is the decrease in the number of horses southward much more rapidly than the decrease in the amount on land under cultivation.

The southward decrease is largely explained by the fact that the horse, like every other animal and plant, has a distinct climatic optimum. Departures from that optimum inevitably cause the number of horses to decline until zero is reached at the extreme limits. But the

asses tend to replace horses, but among people of progressive tendencies only enough asses are kept to serve as breeding animals, and large numbers of mules are raised. (Fig. 17) shows how mules become the dominant work animals as one goes southward in the United States. Their distribution follows the same laws as that of horses so far as the relation to cultivated land and cities is concerned.

Europe illustrates the factors controlling the distribution of horses quite as well as does the United States. (In Fig. 18) horses are distributed almost in proportion to the cultivated land throughout

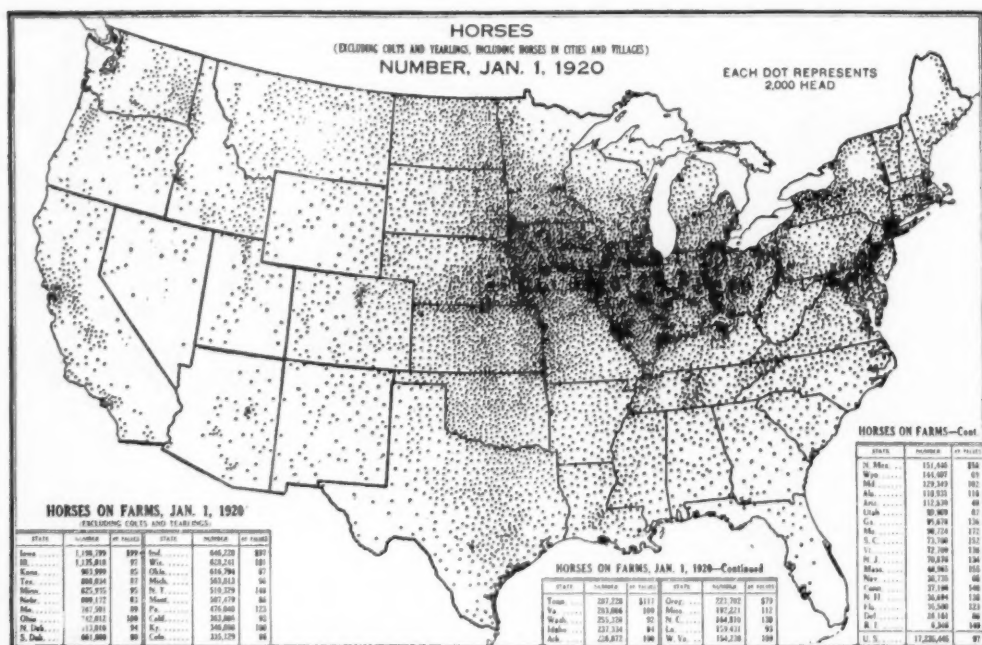


FIGURE 16.—Over one-quarter of the mature horses (2 years old and over) in the United States are in the Corn Belt, and over three-quarters are in the humid eastern half of the country. The small number of horses in the Cotton Belt and the eastern sections of the Corn and Winter Wheat Region is owing in large measure to the preference for mules as work animals in these regions. (See Fig. 17.) (Map and caption from 1921 Yearbook, U. S. Dept. of Agriculture.)

optimum for the ass is different from that of the horse. The ass can stand greater heat, greater drought, coarser food, and greater neglect on the part of its owner. Mules share these qualities, but retain the size and many other good qualities of their dams, which are horses. As climatic conditions become unfavorable for horses by reason of warmth or aridity,

all the central area where the climate is favorable to them. In certain regions, to be sure, there are important concentrations where the number of animals is increased locally by the presence of cities as at London, Paris, Moscow. Other concentrations are due to specially favorable conditions for horse-breeding. For example, the end of Cape Finisterre

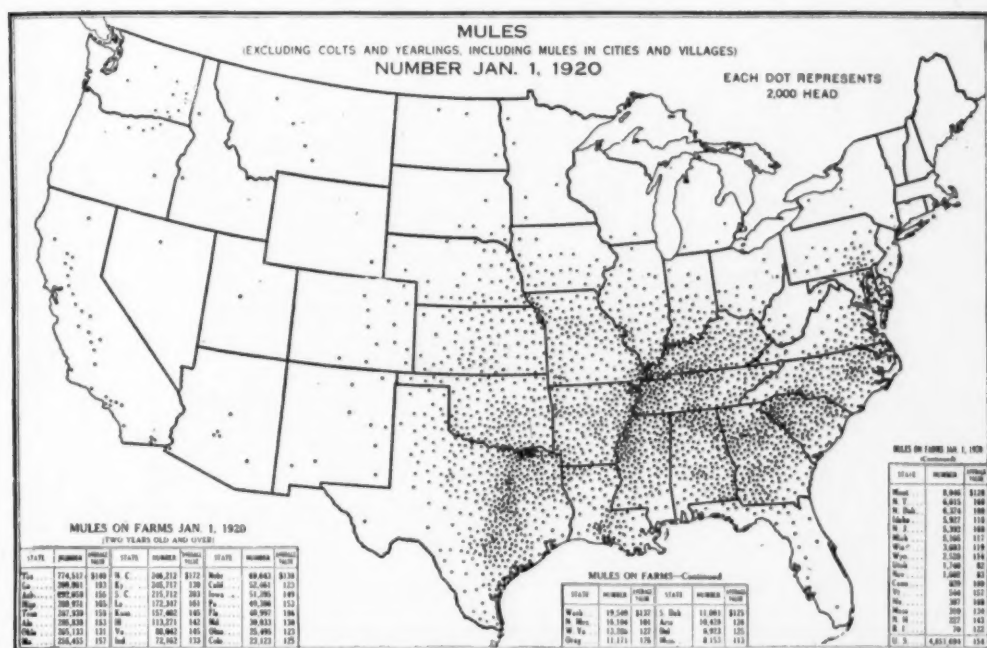


FIGURE 17.—About five-sixths of the mature mules (2 years old and over) in the United States are in the Cotton Belt and the Corn and Winter Wheat Region. In the eastern Cotton Belt (east of Texas and Louisiana), where negro farmers are most numerous, there are twice as many mature mules as horses. The popularity of mules is also increasing in the North and West. (Map and caption from 1921 Yearbook, U. S. Dept. of Agriculture.)

in France has about three horses per capita because the dampness promotes splendid pasture, but is not favorable for crops. Northward and southward the number of horses diminishes faster than does the number of people. In the far north the reindeer is used in place of the horse; in the south the ass is used, with a belt of mules between the main areas of horses and asses (Fig. 19).

In the other continents we can merely suggest the way in which horses decline in number as the standards of progress fall and climate becomes unfavorable. Toward the deserts, the horses, after becoming scarce in the belt where asses are used, almost disappear, and the camel becomes the dominant beast of burden. This is true in spite of the fame of the Arab horse. Among the Arabs, horses are in reality very scarce, so that none but the rich can own them. They have to be most tenderly cared for, are consequently treated almost like members of the family, and are extolled in

poetry and song. In Africa, south of the desert belt, the plains of the Sudan and of the central highlands afford fairly good pasturage for horses, and may support a good many in time, though the climate is not favorable and in places the tsetse fly almost keeps them out. The forests of equatorial Africa depart still farther from the optimum for horses. There the climate, the tsetse fly, and many other pests cause vast areas to be without horses. In fact, practically all domestic animals are so much at a disadvantage in this area that men still carry loads on their heads for hundreds and thousands of miles. Only toward the South where the climate improves and the parasites decline in number do horses again become numerous.

In Asia similar but less extreme conditions prevail. Horses thrive fairly well on the steppes of southern Siberia and are numerous per capita. Among the Khirghiz they are so prized that the word "animal," used alone, generally

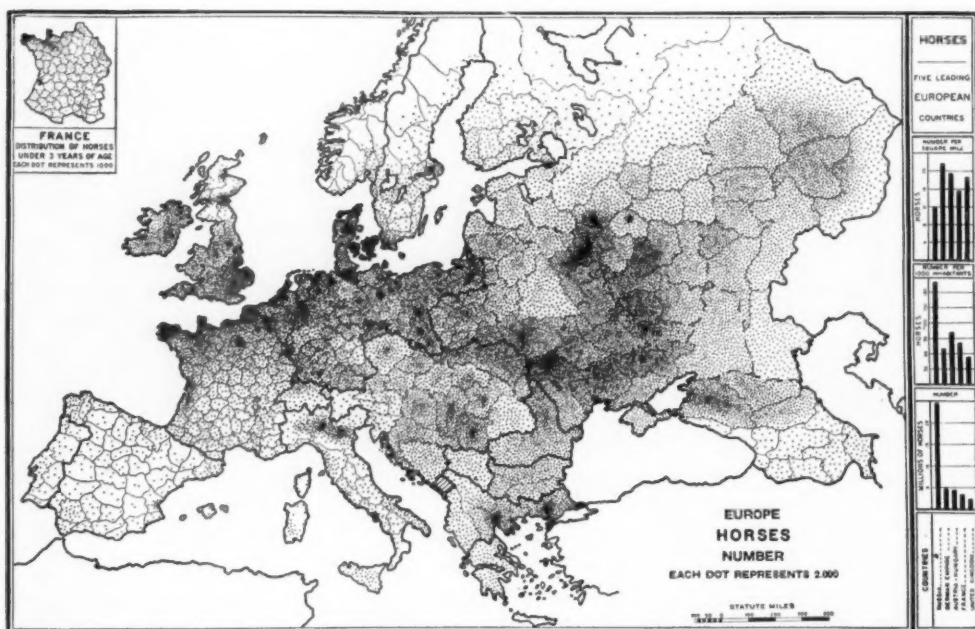


FIGURE 18.—Though horses are more uniformly distributed than other farm animals, there is a noticeable concentration on the north European plain and in the agricultural section of Russia. The large number of horses in Paris, Berlin, and Moscow is noticeable. (The absence of a center near London is due to incomplete statistics.) The horse-breeding industry of France, Belgium, and the United Kingdom, important as it is to the American horse breeders, involves relatively so few animals as to be scarcely noticeable on the general map. The insert map of France is introduced to show the Percheron breeding centers which are discernible in the concentration of dots in Normandy. Of greater local importance, however, is the production of coach horses on the plain of northern Finisterre, where, in spite of a dense population, horses outnumber people three to one. (Map and caption from Finch and Baker "Geography of World Agriculture," U. S. Dept. of Agriculture, 1917.)

means horse. A sheep may be called a "sheep animal." Nevertheless, the number of horses per square mile is small, for the dry climate with its great contrasts between summer and winter does not permit a large population of either men or horses. In northern China and Manchuria horses again become fairly numerous, but are interspersed with asses, mules, and camels as befits the climate. Japan likewise has a fair number of horses per square mile because of the dense population, but the climate and vegetation, and a population so dense that good land cannot be used to raise forage, create conditions so unfavorable that the number per capita is extremely small. Horse breeding is largely confined to specially favored areas in the cooler and drier north.

Southward in Asia a similar decline in horses takes place. In the dry north-

western portion of India, camels and asses supplement horses, oxen do so in the moderately moist parts of the east and south, and water buffaloes become of great importance wherever the climate and the opportunities for irrigation lead to rice culture. In Indo-China and southern China, where the environment is peculiarly unfit for horses, the water buffalo becomes almost the sole beast of burden. Hongkong, for example, in spite of the larger number of English people, has only a handful of horses. Finally, in the parts of Asia that are most continuously warm and moist, and where the tropical forests and their accompanying vegetation are especially unfavorable for horses, asses, or almost any other domestic animals, it becomes worth while for man to supplement his own task of burden-bearing by using elephants. These animals, like the dog

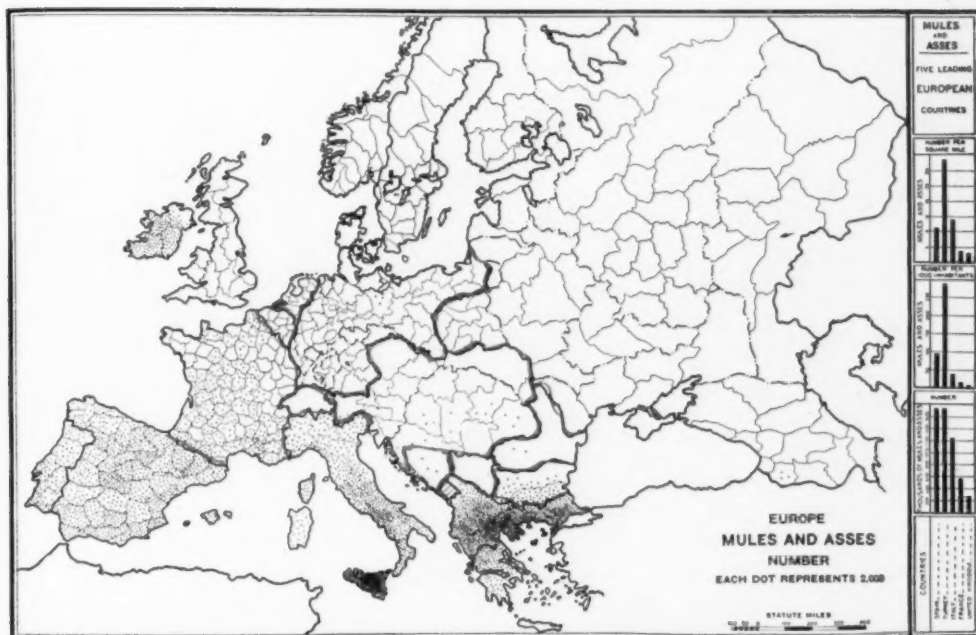


FIGURE 19.—Comparison with Figure 18 indicates a distribution supplementary to that of horses. Because of rainfall distribution the Mediterranean countries have poorer summer pasture than the countries of northwestern Europe. Thus, in Spain horses are most numerous in Galicia, where the rainfall is heaviest, while mules and asses are more numerous on the dry Mediterranean coast. Southern France is noted for its excellent mules. Southern Italy, particularly Sicily, where it is both dry and rough, has more mules and asses than horses. An interesting reflection of agricultural conditions is discernible in the presence of mules and asses in level, humid Ireland, where the farms are small and the farming intensive, and their absence from Scotland, which, though having rougher land, has larger farms and a higher degree of prosperity. (Map and caption from Finch and Baker, "Geography of World Agriculture," U. S. Dept. of Agriculture, 1917.)

and the reindeer in the far north, the yak in the Himalayas, the sheep in Tibet, the llamas in the Andes, and the human coolies in central Africa, the Amazon basin, and parts of southeastern Asia, represent the way in which man turns to poorer and poorer types of animals for transportation, as he finds himself in environments more and more unlike those which are favorable to the horse, the best of all animals for this purpose.

THE DISTRIBUTION OF CATTLE

The distribution of other domestic animals follows the same laws as that of horses, but with important differences in detail. In a general way the world map of cattle (Fig. 20) seems much more like that of population (Fig. 13) than does the map of horses (Fig. 14). It has heavily shaded areas in India as well as in Europe, the United States, and South

America. This does not mean that ordinary cattle rival men in their ability to live in a wide variety of climates, although they are less sensitive than horses to certain pests and diseases of warm regions. The reason for the large number of cattle in southern Asia, and to some extent in Brazil, is that several species are included in Fig. 20. The cattle in Europe, the United States, Australia and most of South America generally represent the European species (*Bos taurus*); those in southern Asia and parts of Brazil, five other species.

If only the European species were considered, the general aspect of Fig. 20 would be much like that of the map of horses. Nevertheless, there would be important differences. The cattle maps of Europe (Fig. 21) and the United States (Fig. 22), for example, show no such aggregation of animals in cities as do the

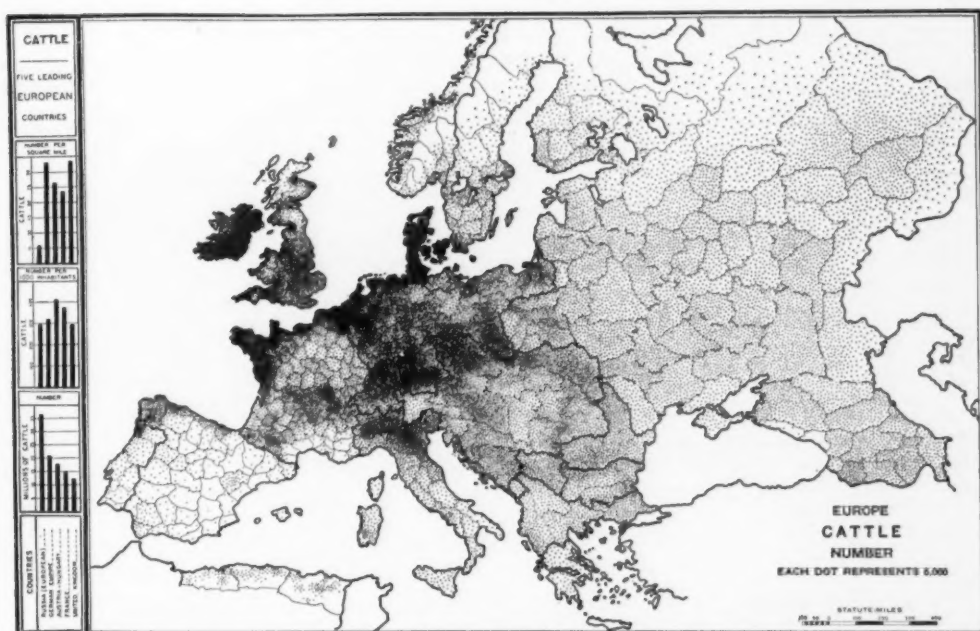


FIGURE 22.—The distribution of cattle is an interesting reflection of conditions of climate, of the pressure of competing agricultural industries, and of the economic status of the rural population. The concentration in Ireland, Denmark, Holland, Belgium, and the northwestern coast of France is particularly noticeable. Ireland, with its evergreen pastures, has 156 cattle per square mile, as compared with 81 in Iowa, 56 in Wisconsin, and 41 in New York. In France the greatest density of cattle is in the departments of Finisterre and Manche, where there is also the greatest density of horses and swine (Figs. 18 and 25). In Russia the poverty of the peasant and low productivity per acre of the land make cattle relatively much less numerous than in northwestern Europe; while in the Mediterranean region the long summer drought prevents the production of sufficient hay and forage to feed a large number of cattle. (Map and caption from Finch and Baker, "Geography of World Agriculture," U. S. Dept. of Agriculture, 1917.)

corresponding maps of horses. Modern transportation permits even so perishable a product as milk to be produced with profit hundreds of miles from the cities where it is consumed. Butter, cheese, and meat can be transported almost any distance. Hence the modern tendency in progressive countries is to keep a considerable number of cows for fresh milk within a few hundred miles of great cities, a smaller number within shorter distance of smaller communities, and a few upon practically every farm. But milch cows that are kept for butter, cheese, or condensed milk are found where the climatic conditions, the forage, and the demands of other crops make them most profitable.

This, however, is true only of European cattle. In Asia, although a few are kept for meat, the main use of cattle of all

kinds is as work animals, especially for plowing and draft purposes. Hence their distribution corresponds closely to that of the farmers though many also are found in the cities.

The conditions most favorable for European cattle are fairly cool moist summers, especially if milk rather than beef is the main object; rain at all seasons, or else irrigation to supply fresh forage; and so little cold weather and snow that the grass is green all the year round. This type of climate is illustrated by Dublin in Fig. 23. The cool summers discourage many kinds of agriculture, but foster an abundant growth of tender, nutritious grasses and other forage plants. If good markets are accessible, the farmers in such regions turn largely to dairy farming, as in the Irish Free State, the Netherlands, and Denmark,

RAINFALL AND TEMPERATURE IN REGIONS ESPECIALLY GOOD AND POOR FOR CATTLE

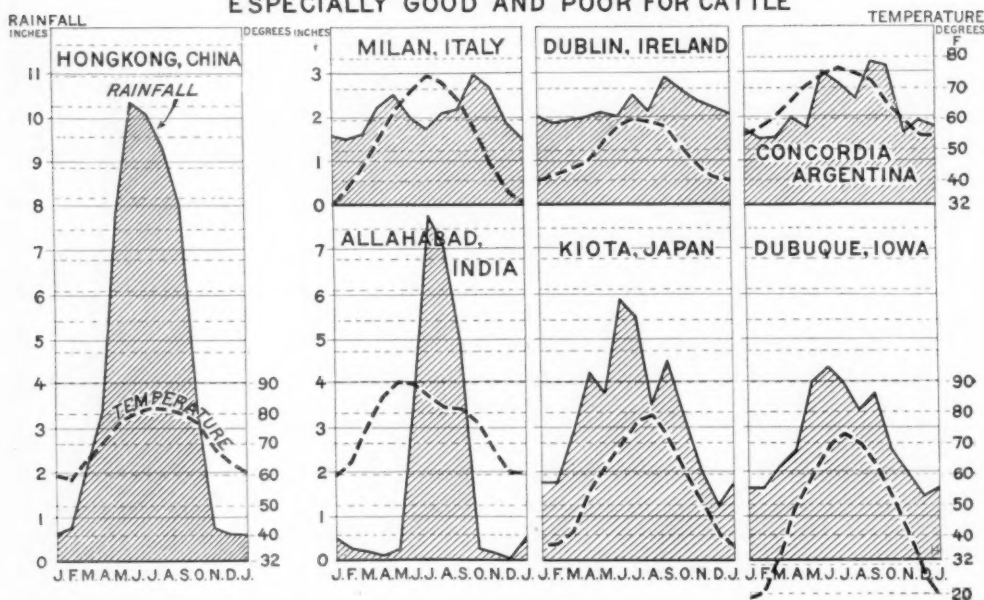


FIGURE 23.—Dotted lines indicate temperature; shading denotes rainfall. The conditions most favorable for European cattle are fairly cool, moist summers; rain at all seasons, or irrigation to supply good fresh forage; and mild weather and little snow to maintain green grass the year round; or, with cold weather and little winter grass, an abundant summer forage crop that can be readily stored. It is easy to see that Hongkong and Allahabad have not favorable climates. It is harder to see why Kiota is not so good as Dubuque or Dublin but the relatively high temperature in winter as well as summer is important. Argentina's nutritious grasses and favorable climate indicate a good cattle country.

each of which countries has 156 cattle per square mile (Fig. 24).

Such equable climates, with admirable conditions for cattle in both summer and winter, are rare. If the summers are cool and moist, but the winters cold, as in Vermont, northern New York, Wisconsin, and Minnesota, the dairy industry is hampered only a little, for low temperature does little harm, provided the cows are housed, and fed on good hay and juicy silage. If the summers are warm enough to raise corn, milk may still be of great importance, as in Iowa (Dubuque curve in Fig. 23), but the fattening of beef cattle is also likely to be highly profitable. For these reasons, and also because it is farther from the great eastern centers of population, Iowa with 23 dairy cattle per square mile falls behind Wisconsin and Vermont, with 41 per square mile; New York, 33; Connecticut, 30; Ohio, 27; Rhode Island, 25; and Pennsylvania, 24, and stands

only a little ahead of Massachusetts and Minnesota, 22, and Illinois and Indiana, 21. On the other hand, Iowa has 58 beef cattle per square mile, whereas its nearest rivals Nebraska, Kansas, Missouri, and Illinois have only 35, 30, 28 and 26 respectively.

A region with fairly moist summers as warm as those of Iowa, and with winters sufficiently moist and warm to support good pasturage but not to make the grasses tough, is excellent for beef cattle. Such conditions permit northeastern Argentina and Uruguay (represented by Concordia in Fig. 23) to be today the world's greatest beef-raising center. Dairy products may also be produced there, but not so well as where the summers are cool.

PHYSICAL ENVIRONMENT AND TYPES OF CATTLE

Different types of environment support different breeds or even species of

cattle. This arises partly from the choice of the breeders, partly from the selective action of nature, and partly from mutations and other causes. A well-known example is the contrast between Holsteins, of which the large milk production seems to be correlated with the highly succulent grasses of North Holland, and the Jerseys of which the rich, creamy milk is probably correlated with the finer, less succulent grasses of the drier hills of the island of Jersey.

The differences between species of cattle are like those between breeds, but more pronounced. Just as the environments of the Dutch coast and Jersey have led to the selection of special types by man and by nature, so the environment of southern Asia has coöperated with other agencies in producing distinct species of cattle such as the Brahman or zebu type, the gayal, the yak, the water buffalo and the banteng. It is these which give the map of southern Asia and the East Indies their heavy shading in

Fig. 20. The Brahmans are the main type of cattle in India, especially in the north where the Indo-Gangetic valley is almost black in Fig. 20. The climate where they are numerous is represented in Fig. 23 by Allahabad. It is warm at all seasons and excessively hot in the spring before the summer rains begin. Its rainfall comes almost entirely in summer, the contrast between seasons being enormous. Cattle which thrive in such a region must live on relatively coarse forage, watery and tender during the rainy summer, but tough and dry in the arid winter. Moreover, they must be able to resist droughts, which are often severe, and must not be sensitive to insect pests, such as the ticks which cause Texas fever.

As long ago as 1849 the knowledge that the Brahman cattle possess such powers of resistance led to the introduction of a few into South Carolina. During the present century a considerable number have been brought to the Texas



FIGURE 24.—Summertime along the Brandywine in Southeastern Pennsylvania. Dairy cattle are densest where the pastures are best; southwestern Pennsylvania has some of the most productive pastures in the United States.

coast, and have been extensively crossed with European cattle. So well do the cross-bred animals endure drought, ticks, flies, and other insect pests, that cattlemen in the tick-infested areas are introducing Brahman blood rapidly. In tropical South America, especially Brazil, the Brahmans have been introduced on a much larger scale. Brazilian cattlemen pay large prices for the best types of bulls.

The climate and vegetation of the southeastern coast of Asia demand peculiar adaptations in the breeds of cattle; there also dwells the greatest population which lacks an adequate supply of domestic animals. Hongkong, with its heavy rains and high temperature throughout most of the year represents the extreme of this type (Fig. 23). Among the dairy cows kept there by the British the yield of milk appears to decline seasonally when the weather becomes excessively hot and damp. The native grasses are so large and coarse that horses, cattle and sheep cannot thrive on them. Hence, the few dairy

cattle are fed on guinea grass, a species introduced from more tropical regions and grown as a cultivated crop. Even this is so poor that it is considered necessary to give the cows special feed; and yet the cattle imported from Europe are subject to all sorts of diseases, and die at a discouraging rate. Because domestic animals fail to thrive in South China, millions of acres of rugged land, such as form the finest pastures in Switzerland, are left unused. In Japan, although the conditions are not so bad as in southern China, successive attempts to introduce sheep have failed; in the most populous parts of the island neither horses, cattle nor swine really thrive. The rainfall, as represented by Kyoto in Fig. 23, does not greatly exceed that of Iowa, but abundance of moisture throughout the year and no cold winter to check growth, cause the Japanese vegetation to be very poor as forage. Iowa, with its warm summers and cold winters, with its natural grasslands and restricted, open forests is almost ideal for cattle; Japan with its

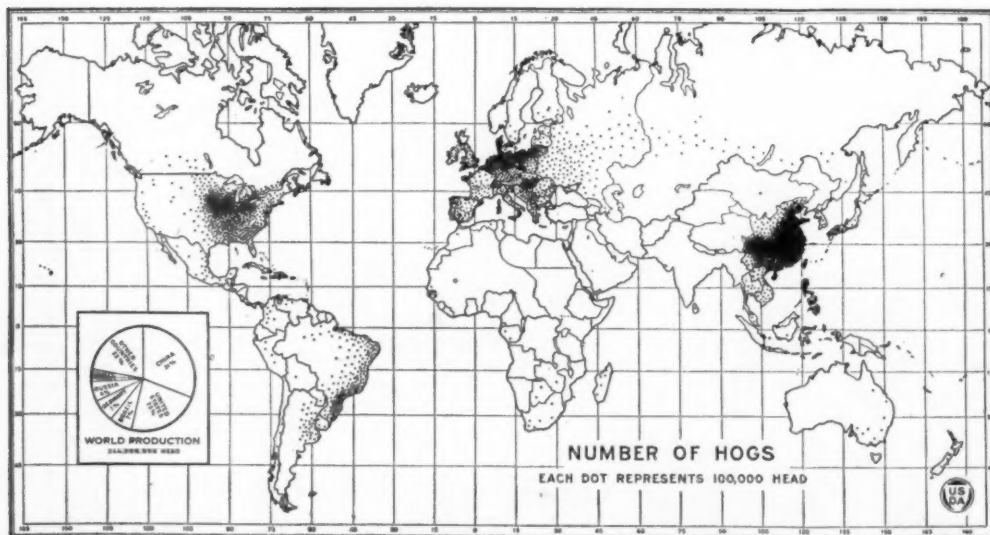


FIGURE 25.—The centers of densest hog production are the corn belts of the United States and Hungary, the potato and dairying belt of northern Europe, and China, where hogs are fed largely on waste products and barley. Little is known about hog production in China, and the figures used are only estimates. In the corn-growing regions of Argentina and southern Brazil the number of hogs is increasing. Hogs are not numerous in tropical countries, because such countries, as a rule, are not densely populated and are provided with vegetable oils to supply the fats needed by man. Moreover, in the tropical and subtropical climates hogs suffer more from parasites and diseases than in temperate climates. Religion practically excludes hogs from India, Turkey, and certain other parts of Asia; also from parts of Africa. (Map and caption from 1922 Yearbook, U. S. Dept. of Agriculture.)

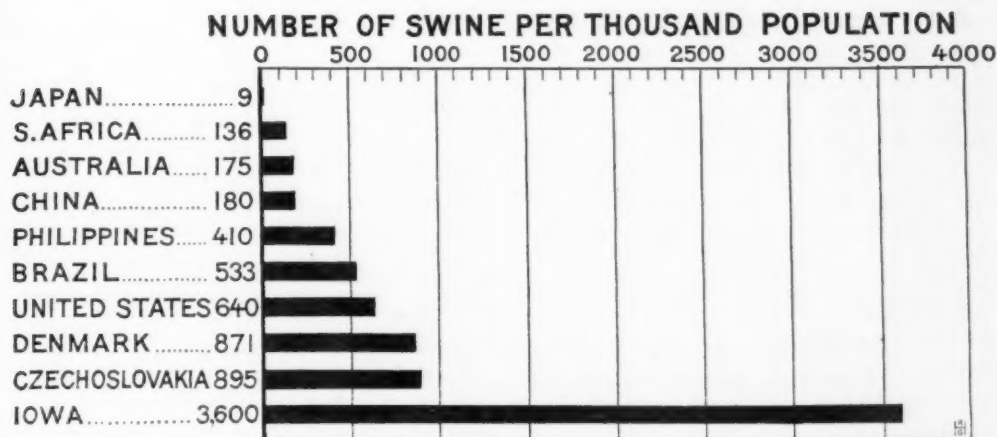


FIGURE 26.—The number of swine per capita depends not only upon geographic and economic influences but upon the prejudices of religion and custom, and the attributes of the hog himself, as well. The hog provides a quick supply of good food from comparatively little feed, some of which is not used by other animals, but the animal's offensiveness tends to restrict its distribution.

dense, damp forests and coarse, reed-like grasses apparently constitutes an unfit environment. Hence Japan has only 25 cattle per thousand people and only 9 per square mile, or 45 if we count only the productive land. Contrast this with Iowa with its 1,850 cattle per thousand people and 81 per square mile, or over 100 if we reckon only the cultivable land.

THE DISTRIBUTION OF SWINE

Domestic swine possess several qualities which would seem to favor an extremely wide distribution much like that of man himself. In the first place, swine breed so fast and grow so rapidly that they furnish a greater supply of human food than cattle in proportion to what they eat. Second, they eat many kinds of food, such as acorns, potatoes, and garbage, which are not of much use for most of the domestic animals. Third, although the exact facts are not known, domestic swine, like cattle, appear to be descended from several wild species which are sufficiently alike to breed productively. Thus the number of varieties is great, and there seems to be some form adapted to almost every kind of environment.

In spite of these advantages swine are not nearly so widely distributed as horses, cattle, hens, or even sheep. Even if we

had data for China in Fig. 25, the map would not look much like that of population (Fig. 13). In the United States the swine show a marked tendency to be concentrated in the states from Ohio to Nebraska, while in Europe they abound in the low countries, Denmark and western Germany. South America, especially Brazil, has a fair number distributed much as are the people; the Philippines nearly as many in proportion to the population; China, Australia, and South Africa about one-fourth as many proportionally as in the United States, and Japan a few,—half as many as Australia, but only one-twentieth as many per capita (Fig. 26). Vast areas in Asia and Africa are utterly blank in Fig. 25. In the United States such densely settled sections as the northeastern states have surprisingly few; while Europe displays such curious features as the bay of few swine projecting from that portion of Poland that formerly belonged to Russia into a land of many swine in Polish territory that was formerly German and Austrian.

The explanation of these conditions is found partly in the fact that although the pig eats nearly everything it becomes commercially profitable chiefly in regions where corn is cheap and abundant, as in Iowa and adjacent territory; or potatoes,

as in Belgium, the Netherlands and Germany; or barley and skim milk, as in Denmark. Relatively high prices for these commodities, even where they are abundant, may reduce the production of swine. This happens near Chicago, where corn is relatively more costly than it is farther from the great cities. Economic or political limitations such as tariffs are also a factor in curtailing the distribution of swine.

The offensiveness of the pig is another reason why its distribution differs so much from that of man. In cities and towns all over the civilized world vast amounts of garbage which might be profitably employed for feeding swine, if only those animals were pleasant neighbors, are taken to rendering plants where the fats are extracted, or are disposed of as fertilizer or otherwise. Most people object to the smell of pig pens. Although no exact information is available, it is probable that the religious prejudice against swine arose in part because the animal is disagreeable. The fact that swine are tabooed by Mohammedanism, Judaism, and Hinduism accounts largely for their

absence throughout most of Asia and Africa. It may explain the curious way in which the number of swine shows a sudden diminution as one passes from old Germany and Austria to the territory of the former Russian province of Poland. At any rate that region has long contained a large and influential population of Jews who were formerly forbidden to enter "Great Russia" farther east, but were tolerated in Poland and the neighboring provinces.

In China there is no prejudice against swine and they are kept in almost every village. Nevertheless, the number is not so large as is often supposed. Unlike draft animals which rely on grass, swine compete, so to speak, with man for food. A very dense and poverty-stricken population cannot afford to feed swine on anything that people can eat. In China it would seem almost criminal to use corn, barley, potatoes and skim milk for hog feed.

THE DISTRIBUTION OF SHEEP AND GOATS

If the world were limited to four domestic animals the choice would probably



FIGURE 27.—Four of the six densest centers of sheep raising—Australia, the Argentine-Uruguay area, the Union of South Africa, and New Zealand—are in the Southern Hemisphere. These are relatively new lands with sparse population. In the Mediterranean countries topography and climate favor the sheep industry, which is semi-nomadic in character. In Great Britain the large area of pasture makes mutton and wool production a prominent industry in spite of dense population and high-priced land. (Map and caption from 1923 Yearbook, U. S. Dept. of Agriculture.)

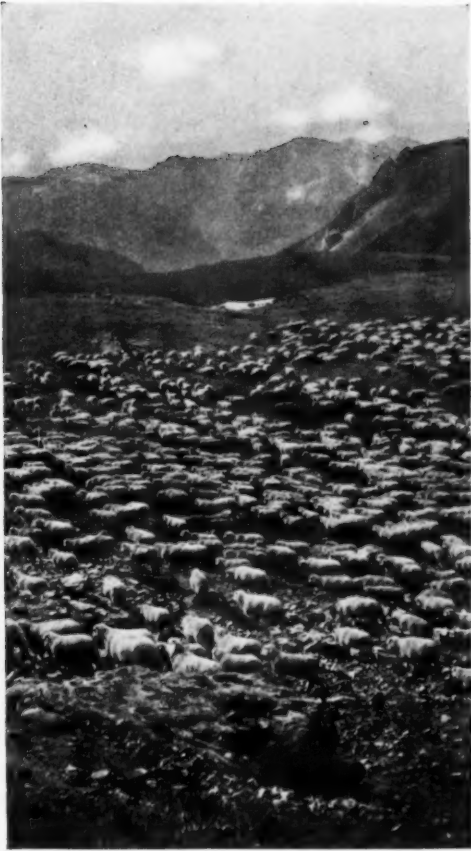


FIGURE 28.—A flock of sheep in the San Juan mountains of Colorado. Sheep can find feed in deserts, where cattle would starve, and also do better than cattle on alpine pastures in the high mountains. Since they are adapted to a wide range of climatic conditions and since their wool and meat can readily be shipped almost anywhere, they are largely relegated to dry or hilly regions. (Photo by W. W. Atwood.)

be horses for transportation, dairy cattle and pigs for food, and sheep for clothing. Nevertheless, as appears in Fig. 27, sheep are generally crowded out of the regions where population is numerous, and intensive farming is practised, whereas horses and cattle are most numerous in such regions. One reason is that sheep are better adapted than horses or cattle to dry and rugged regions of sparse population. They can thrive on grass so short that other animals cannot bite it off, and they can graze on steep slopes more comfortably than other domestic animals except the goat. Another important

reason is that although wool is highly valuable, it is not so essential as draft power, milk or meat. Again, sheep can be raised and fattened on grass alone more easily than the other domestic animals, or at least it is less common to feed them with grain and with special forage crops than the other domestic animals. Moreover, wool is one of the easiest of all animal products to raise and to transport. Sheep require only a few people to care for them; their wool can be washed and clipped, and can then be transported vast distances without further treatment and without the special precautions that are needed for meat. Since other animals are almost everywhere available for meat, the sheep of Australia and South America were long kept entirely for their wool.

Still another fact which causes the distribution of sheep to differ from that of people is the extreme helplessness of the animal. Such helplessness necessitates shepherds, but in progressive countries it does not pay to employ shepherds unless large numbers of sheep are kept. That in turn demands large open areas such as exist in countries which are sparsely populated, either because of newness, or because of aridity or ruggedness. In many parts of the United States where settlement is dense and the enclosures relatively small, sheep cannot be kept without a shepherd unless placed in enclosures so well fenced that dogs cannot get in and kill them (Fig. 28).

For all these reasons sheep tend to be numerous in marginal areas, like the four portions of the southern hemisphere where they abound—New Zealand, Australia, South Africa and the Argentine-Uruguay section—and in certain European areas, like Britain, the Balkans, and southern Italy. The four areas south of the Equator are all newly settled regions where population is still sparse, so that land is economically available for uses like sheep-raising. As soon as the population becomes sufficiently dense to make the holdings small, and to create a market for milk, vegetables, and a variety



FIGURE 29.—These goats are moving into the national forests of the San Juan mountains for summer grazing. In semi-arid climates characterized by scrubby vegetation goats are often more common than sheep. In regions where they are abundant, as in Greece, they supply not only meat and hides, but milk and hair. The hair of Angora goats is known as mohair and is especially valuable. (Photo by W. W. Atwood.)

of farm products, sheep give way to cattle and general farming, except where other conditions make farming unprofitable. In Australia and South Africa, as a matter of fact, most of the sheep are raised on land so dry that if devoted to general agriculture, the danger of frequent and severe crop failures would always impend. The same is true of considerable parts of Argentina.

In the Balkan region, southern Italy, Sicily, and in fact all about the Mediterranean, long experience has proved that it does not pay to try to farm the dry hillsides, or to raise cattle on them, and so sheep are numerous. Because the prolonged summer droughts make it difficult to get a living by other methods in these regions, it is profitable to raise sheep. In Britain an unusual combination of climatic, economic and social conditions produces the unique combination of numerous horses, cattle, and sheep all in practically the same regions; but even there sheep are abundant chiefly because Britain is almost too cool and moist for profitable general farming. It does not pay to farm large portions of Britain so long as food can be brought across the seas more economi-

cally in exchange for manufactured goods. Thus even Britain bears out the idea that sheep are relatively marginal animals.

Goats bear to sheep much the same relation as asses to horses, and Brahman to European cattle. They supplant the more valuable animal only in regions that are especially rugged or characterized by shrubby rather than grassy vegetation (Fig. 29). In one important respect the relation between goats and sheep is the reverse of that between Brahman and European cattle. The goat is a much better producer of milk than is the sheep. An average cow yields some three or four thousand pounds of milk per year, the average ewe less than one hundred, and the nanny goat five hundred to a thousand. Hence in relatively dry countries the goat may replace the cow as a source of milk, as in many places in South Africa, northern India, Mexico, and about the Mediterranean Sea, especially in Greece and the Balkans, where goats reach their greatest density per square mile. In that case its distribution approaches that of the people. In the eastern Mediterranean lands both the goat and sheep are kept for the most

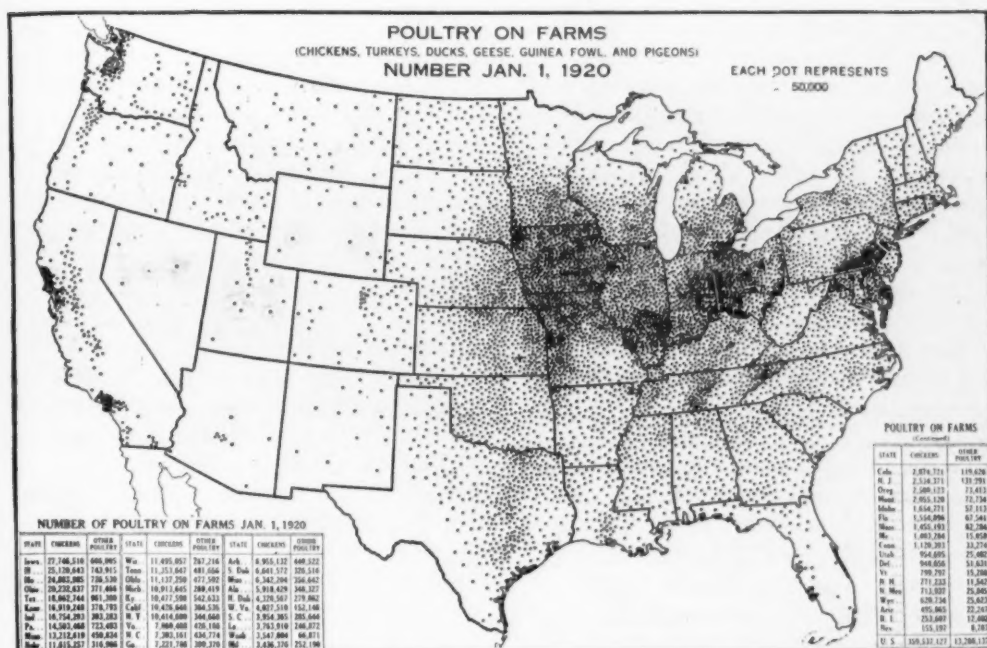


FIGURE 30.—Half of the poultry in the United States are in the Corn Belt and around its margin, where feed is cheap. But the two most notable districts of production are the counties in south-eastern Pennsylvania, near Philadelphia, and Sonoma County, Calif., especially the district around Petaluma. Six counties in southeastern Pennsylvania had nearly 5 million poultry on January 1, 1920, or 4,000 to the square mile; while in Sonoma County there were over 3 million poultry, with sales of eggs and chickens amounting to over 12 million dollars in 1919. Los Angeles County, Calif., had 1,350,000 poultry. The California cities are supplied largely from these two counties; but the eastern cities draw their supplies from a much wider territory. (Map and caption from 1921 Year-book, U. S. Dept. of Agriculture.)

part in the villages. This is possible because the dryness of the summers and the general ruggedness cause waste land to be abundant. The grain fields are generally unfenced and can be used for pasturage in summer; the harvest is usually finished by June. Moreover, since standards of living are so low that children do not go to school, the village boys can be employed to herd the goats and sheep, and fences are unnecessary.

THE CONTRAST BETWEEN HENS AND SILKWORMS

The last two domestic animals which it is worth while to discuss here present a marked contrast. The hen possesses most of the qualities which lead to wide-spread distribution; the silkworm goes to the opposite extreme. Some of the qualities which tend to cause hens to be widely distributed are the following: (1) Hens

are peculiarly independent of climate, perhaps because they were derived from several wild ancestors in different parts of the world. (2) They are as cosmopolitan as man himself or the pig in their choice of food, and can thrive almost anywhere on the food that people discard. (3) The products for which they are chiefly valuable cannot easily be transported. Even with modern methods of refrigeration, the small size of the individual animal makes slaughtering, cold storage and transportation for meat relatively expensive. The transportation of eggs is, of course, expensive because of the loss from breakage which may amount to as much as 15 per cent. Moreover, eggs quickly lose the essential quality of freshness when transported.

The net result is that the distribution of hens is much like that of farms all over the world, except in two respects (Fig. 30).

First, the lower the stage of civilization, the smaller the number of hens per capita and per square mile, as appears from their relative scarcity in tropical countries. Second, hens tend to be especially numerous in favorable localities near great markets as in eastern Pennsylvania and New Jersey, and in regions with an especially good supply of food, as in the Corn Belt of the United States from Ohio to Iowa (Fig. 31).

In connection with hens it is interesting to note the distribution of ducks and geese. In most countries these birds are insignificant, but in the low countries of Europe, in Japan, and especially China, they rise to real importance. This is because such regions have abundant water in canals for irrigation or other purposes. Where rice is raised domestic waterfowl are especially likely

to be abundant, as in South China. There one often sees them herded by small boys with long sticks who drive them as readily as the shepherd boys of western Asia drive their sheep. Northward from the ricelands of China extends a section so cold that the water courses are frozen for some time in winter, and there ducks and geese decline greatly in number.

THE LIMITATIONS OF THE SILKWORM

The silkworm is peculiarly interesting because it illustrates the way in which the distribution of domestic animals is subject to expansion by man and to limitations by nature. The silkworm was first raised in China. Its cocoon produced so valuable a textile material that other nations greatly desired it. At first the silk was exported from China;



FIGURE 31.—A flock of chickens in a Wyoming village. Chickens can be kept on small areas of land and are highly efficient in transforming feed into human food. They are adapted to a wide range of climatic conditions and a great variety of feeds, so are found almost everywhere that man is found. (Courtesy of Ginn and Co., Boston.)

but later—by stealth according to the old stories—the eggs of the worm and the seed of the mulberry tree on which it thrives were carried to India, thence to Persia, and finally to Constantinople and Europe at the behest of the Emperor Justinian, about 550 A.D. Subsequently silk culture spread through the Mediterranean lands, and quickly reached its maximum expansion. Efforts were made to introduce it into England, and likewise into Mexico and Virginia in early colonial days. As late as the American Revolution, Benjamin Franklin was engaged in a silk enterprise in Philadelphia, while in 1866 California was offering bounties for the cultivation of silk.

All these efforts proved abortive because the silkworm is subject to very strict geographical limitations, and because the durability and imperishability of raw silk and its high value, over seven dollars a pound on the New York market from 1921 to 1924, render the cost of transportation negligible. It is a matter of indifference to New York whether it gets its silk from Japan and China, or from Westchester County thirty miles away. But it will be a long time before New York will be satisfied with "fresh laid eggs" from China, even though it may use powdered Chinese eggs for custards. Because of these geographic limitations and economic qualities the restrictions of silk culture are rapidly concentrating the work in the region where it originated.

The first limitation of silk culture is set by the mulberry tree. No other easily-grown tree provides leaves on which the silkworm can thrive. The various species of mulberry grow in the warmer parts of the temperate zone and in semi-tropical regions, but do not thrive in equatorial lands except on the mountains. With proper care they can be raised in regions as cool as Philadelphia and southern England, but thrive better somewhat farther south. Thus the mulberry tree limits silk cultivation to a zone on either side of the equator lying roughly between latitude 15° and 40° ,

although in Europe and western America the limit rises to about 45° .

The next limit is set by standards of living and habits of industry. The rearing of silkworms is a very painstaking and laborious occupation which requires a great concentration of work during a short season. Fresh leaves must be cut daily with absolute regularity, the trays on which the worms are kept must be cleaned, the air must be maintained fresh and equable, neither too hot nor too cold. The labor must be cheap or the cost of production will be greater than the market can stand. Such labor is found only among people with a low standard of living combined with established habits of great regularity and industry. In America no such labor has ever existed on a large scale, for neither the Indians nor the negroes display the steadiness which is so pronounced a characteristic of the Chinese and Japanese, while European labor in America has always been restless and expensive. Only in such places as Japan, China, northern India, Persia, and the Mediterranean lands does one find suitable labor, and thence comes the silk.

Another natural limitation is the degree of moisture during the season when the worms are growing (Fig. 32). In regions with the Mediterranean type of climate, unless irrigation is practiced, there is always danger that the rainy season will end too soon, so that fresh mulberry leaves will be scarce. In China and Japan, on the contrary, where the rains come in summer, fresh leaves can be procured for many months instead of only a few weeks. The danger from the many diseases to which the silkworm is subject is indeed increased, but this does not offset the great advantage of the rainy summers, as well as of the labor supply.

Finally, silk raising is likely to be still more limited in the future by the fact that some varieties of silkworms produce only one generation per year, that is, the eggs laid one spring hatch the next, whereas other varieties are bivoltine, that

is, the eggs laid in the spring hatch in a few weeks, and another set of worms is raised the same year. Still others are multivoltine so that several generations are raised in a year. Already modern science appears to be able to produce varieties of which the eggs can be hatched whenever desired, so that worms may be available at any season. In this way the work of raising silk is changing from an

though not cold, winters. Naturally the silk industry is diminishing in importance in the Mediterranean countries, and growing rapidly in importance in China and almost as fast in Japan.

As methods of transportation and storage become still better, and as peace and international harmony become more fully assured, the distribution of all sorts of products, including plants as well as



FIGURE 32.—Silk worms feeding on mulberry leaves. Since this genus of trees affords by far the best feed, sericulture is confined to the regions where the mulberry can be grown. Since there is a great amount of labor connected with silk production, and the product has so high a value that it can be shipped around the world at a relatively small cost, sericulture within the mulberry zone is restricted to those countries where labor is abundant and cheap. (Courtesy of Belding Bros. and Co., New York.)

occupation requiring a great many unskilled people for a few weeks in the spring to one requiring considerable skill among part of the workers, and the continuous employment of even the unskilled workers as long as fresh mulberry leaves are available. Under such conditions a place like the Canton region, so warm and moist that the mulberry tree sends forth leaves during much of the year, has a great advantage over Mediterranean lands where the growth of the trees is limited both by low temperature in winter and drought in summer, or even over Japan with its cool,

animals, tends to progress like that of silk. First, the area where the product is raised tends to expand; then it contracts, and production becomes intensified in the most favorable areas. The recent production of artificial silk on a large scale illustrates another important element in the distribution of animals. Just as the horse has been partly displaced by the automobile, so the silkworm is being displaced by artificially treated cotton. It remains to be seen how far modern engineering and chemistry can displace domestic animals of all kinds.

AN ANALYSIS OF THE APPLE INDUSTRY OF THE ANNAPOLIS-CORNWALLIS VALLEY

Charles C. Colby

THE apple industry of the Annapolis-Cornwallis Valley is the most highly specialized and prosperous agricultural industry in Nova Scotia. In fact, in 1922, when this survey was begun, the industry and the small district in which it is developed, stood out in striking contrast to the general dullness of the agricultural fabric of Maritime Canada. The apple industry is particularly significant in the district because it represents the principal cash crop on many farms and an important cash crop on many others.

STATUS OF THE INDUSTRY AND ITS GEOGRAPHIC CHALLENGE

The annual production of commercial apples in Nova Scotia during the last decade has been approximately 1,400,000 barrels, and in 1919 and again in 1921 it exceeded 2,000,000 barrels. The value of the crop in 1920 as represented by the prices paid to growers approximated \$4,000,000, while the total value of the pack in that year as represented by the wholesale market prices of graded fruit, including all charges such as packing, insurance, transportation, and marketing, was more than \$10,900,000.¹ In a normal year 60 per cent of the crop or more is exported to Great Britain, and this overseas market is of the utmost significance to the continued prosperity of the industry and the district. In the fiscal year ending March 31, 1923, 1,060,819 barrels of apples valued at \$4,500,000 to the growers, were exported from Nova Scotia to Great Britain. This represented 80 per cent of the exports of apples from Canada to that market. Although small shipments of apples from other provinces may have been made through Nova Scotian ports,

and although some apples from other sections of the province are included in the total, at least 90 per cent of the apples exported from Nova Scotia to Great Britain originate in the Annapolis-Cornwallis District. The volume of this trade approximately equals the exports of apples from the United States to Great Britain and is the largest regular movement of apples from a single producing district to an overseas market. It is of sufficient importance to affect the operation of many ships plying the North Atlantic in the autumn and early winter when the fruit is moving.

While an apple orchard, or at least a kitchen plot containing a few apple trees, is a feature on most farms in the Maritime Provinces, commercial production practically is limited to the Annapolis-Cornwallis Valley, which is a long, narrow, relatively level, sedimentary floored lowland, open at its ends to the sea.² At the north it is separated from the Bay of Fundy, to which it is roughly parallel, by North Mountain, which, from the floor of the valley or from the bay, appears as a fairly steep-sided, even-crested, forested ridge. The summit of this ridge varies from one to six miles in width and in some places is level enough to be farmed (Figs. 1 and 2). At the south the valley is flanked by South Mountain,—the steep, north-facing escarpment of the irregularly surfaced, rocky, crystalline upland occupying Central and Southern Nova Scotia. Much of the fine forest origi-

² The Annapolis River drains only the western part of the Annapolis-Cornwallis Valley, the eastern part being drained into Minas Basin by the Cornwallis, Gaspereau, and Canard rivers and several lesser streams. The broad divide between the Annapolis and Cornwallis rivers lies near Berwick, one of the important centers of apple production.

¹ *Canada Year Book*, 1921, p. 255.



FIGURE 1.—The Annapolis Valley. The long, narrow, cultivated floor of this valley lies between the forested slopes of South Mountain, occupying the left half of the view, and North Mountain, whose abrupt slopes and even crest are seen in the upper right hand corner. Annapolis Basin, into which the Annapolis River empties, shows in the background at the far end of the valley, while the bay of Fundy appears dimly at the right, beyond North Mountain. South Mountain appears as a mountain only when viewed from the floor of the valley, for in reality it is the steep northern slope of the broad granitic upland which occupies most of western Nova Scotia. The view shows the western third of the longitudinal lowland called the Annapolis-Cornwallis Valley. (Courtesy of The Royal Canadian Air Force.)

nally covering this upland has been cut or burned, so that today, except for tiny farmed patches or mining camps along the river valleys, most of the upland is unoccupied. Between these two relatively unproductive uplands lies the Annapolis-Cornwallis Valley, which, with the contiguous lowlands bordering Avon River, makes up the most productive agricultural district in Nova Scotia. This district is not more than one hundred miles long and varies from three to ten miles in width. It extends in a general west-east direction from Digby on the Annapolis Basin to Windsor on the Avon River. In it apples are

associated with hay and potatoes as the more important money crops. While, on most farms, diversified farming is practiced, in a majority of cases the apple crop constitutes the center of interest. Locally the apple district and the Annapolis-Cornwallis Valley are thought of as synonymous and that practice will be followed in the present analysis.

The localization of the Nova Scotian apple industry in the Annapolis-Cornwallis District is striking. Seventy-seven per cent of all of the apple trees in the province are in Annapolis, Kings and Hants counties, the three counties

in which the Annapolis-Cornwallis Valley lies; 68 per cent are in Annapolis and Kings counties, and 47 per cent are in Kings County alone (Fig. 3). Kings County includes the eastern end of the Annapolis-Cornwallis Valley, and it is claimed that within twenty-five miles of Kentville, the shiretown of the county, are grown 75 per cent of the apples produced in the province. In fact, Kentville may be said to be the center of the industry, for here are located both the United Fruit Company, through which most of the apples are marketed,

as in other fruit industries. Nevertheless, the orchards return a profit with sufficient regularity to induce a spirit of well being and contentment throughout the pleasant length of present-day Acadia. This regularity of return accrues from a surprisingly uniform annual production, combined with equally consistent sales in the British markets. Naturally, the return varies with the prices current in a particular season, but the fact remains that a majority of orchardists year by year have apples to sell and sell them. An explanation of

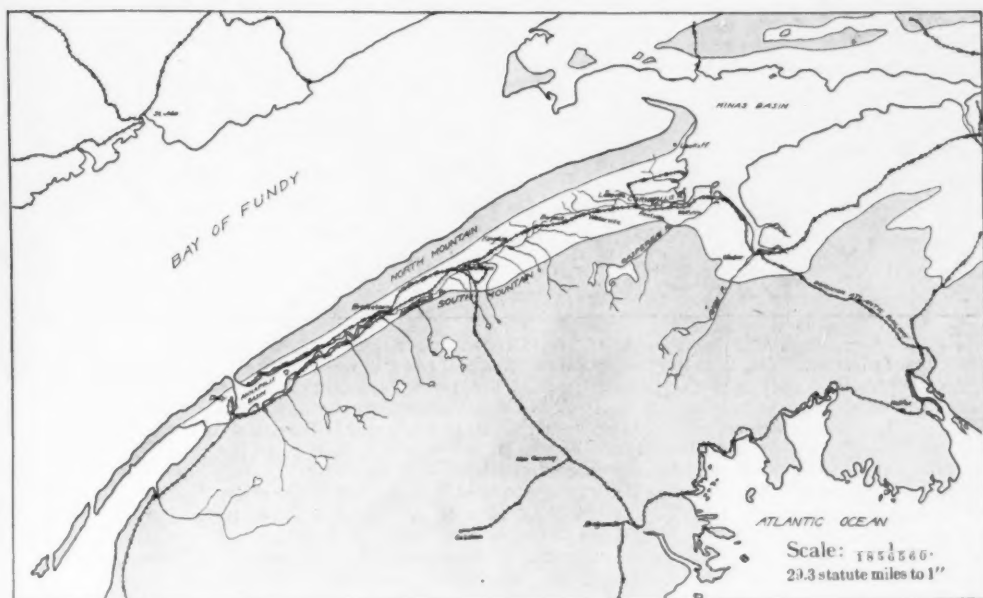


FIGURE 2.—The Annapolis-Cornwallis Apple District extends from Digby on the Annapolis Basin to Windsor on Avon River and lies between crystalline uplands which show on the map as shaded areas. The railway stations marked are the principle apple-shipping points. Except for the county names, this map carries the place names to which reference is made.

and the headquarters of the Dominion and Atlantic Railway, over which the fruit moves to Halifax.³

It should not be thought that apple culture has proved a bonanza for these Nova Scotian farmers, or that the industry has no further problems to solve. Few men have become wealthy from their orchards. There are discouraging circumstances and unprofitable seasons

this regularity of production and sales drives directly at the pulse of the industry, for it discloses the ways in which and the extent to which the geographic endowment of the Annapolis-Cornwallis Valley is being utilized.

PART I. REGULARITY OF CROP PRODUCTION

Although apples have been grown in the Annapolis-Cornwallis Valley practically ever since it was settled, commer-

³ Harris, H. G.: "Kentville—The Heart of the Valley," *The Busy East*, Oct., 1924, p. 41.

THE DISTRIBUTION OF APPLE TREES IN NOVA SCOTIA IN 1921

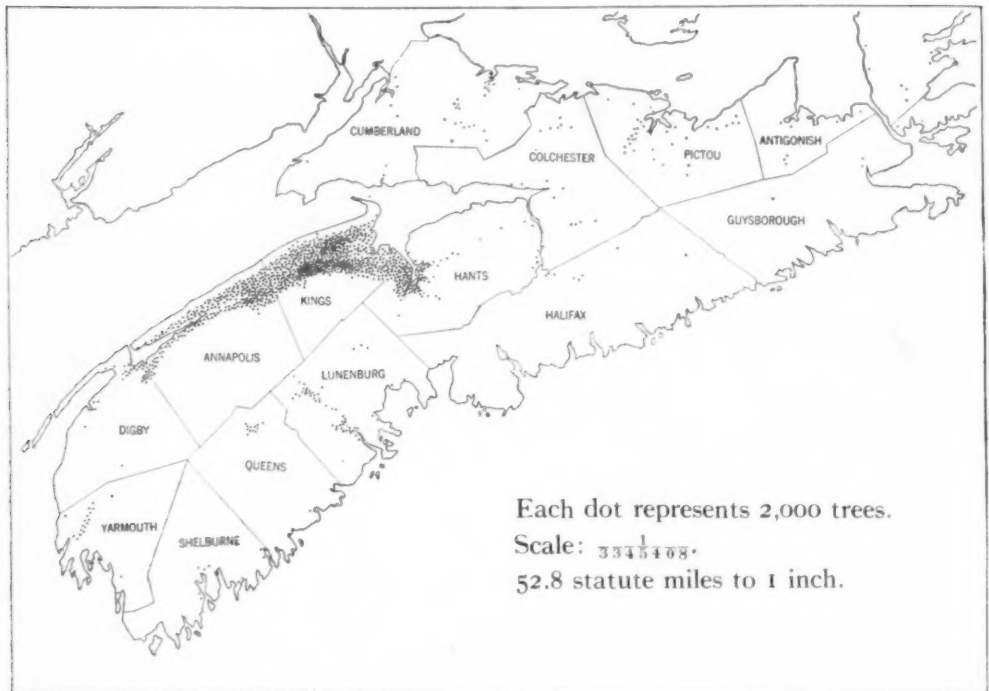


FIGURE 3.—The distribution of apple trees in Nova Scotia, based on the county totals reported in the census of 1921. The dots are placed more accurately in the western part of the province than in the eastern. The outline of the principal producing district is practically correct, for apple culture is so definitely adjusted to the Annapolis-Cornwallis Valley that the boundaries of the area are well known. Likewise, the concentration of dots within this valley and in Queens and Lunenburg counties was governed by the facts of distribution discussed in the text. In the eastern counties, where production is not on a commercial basis, the actual distribution of apple trees is probably more widespread than the dots suggest. However, all of the dots are placed in the farmed areas as shown on the land classification maps appearing in B. E. Fernow's, "Forest Conditions of Nova Scotia," Commission of Conservation, 1912, and many of them are in places mentioned by Shaw and others as suited to apple culture. In western Nova Scotia the percentage of distributive error probably is not over 20 per cent; in the eastern part of the province it may be in some places as high as 50 per cent.

cial production did not begin until about 1880. Since then apple culture has changed from a secondary interest concerned with a crop grown primarily for local consumption to a specialized fruit industry. The record of production in the accompanying Figure 3 shows the growth of the industry in the twenty-two years from 1903 to 1924 inclusive. During this interval three distinct periods of production are recognizable. From 1903 to 1910 inclusive the average production was 450,000 barrels, from 1911 to 1918 inclusive it was 850,000, and from 1919 to 1924 inclusive it was 1,864,000 barrels.

The increased production from the first to the second period was due to an increase in the number of bearing trees in the province⁴ (Table I), and to the

TABLE I
Apple Trees in Nova Scotia and in the Principal Producing Counties in 1901, 1911 and 1921*

	1901	1911	1921
Nova Scotia...	1,975,575	2,481,040	2,180,423
Annapolis County.....	388,651	516,761	468,818
Digby.....	89,558	83,450	67,056
Hants.....	175,325	228,139	195,227
Kings.....	681,589	1,085,685	1,019,461
Lunenburg....	147,651	157,189	105,662

* Census of Canada.

⁴ *Annual Report of the Secretary for Agriculture, Nova Scotia, 1910, Pt. II, pp. 3, 8.*

greater care given the orchards. Between 1895 and 1910 many additional farmers recognized the economic possibilities of apple culture. Apparently the meetings and reports of the Fruit Growers' Association of Nova Scotia factored in this respect. For instance, about 1906 one of the growers publicly submitted a statement, later verified by a committee of the Fruit Growers' Association, "showing the net profits of some dozen full-grown, well-cared-for orchards in the valley to be about 16 per cent annually on a valuation of \$1,000 per acre."⁵ Writing in 1910 he states: "Ten years ago a \$20,000 orchard was considered so only on paper. Now there are scores of farms valued at that, almost entirely from their orchards. . . . This year some young orchards, only getting nicely under way, not really having commenced their business career, will pay, if markets hold as good as expected, better than bank interest on \$60,000."⁶

During this period sprays to combat the ravages of insect pests came into general use, and the value of commercial fertilizers and cover crops became widely recognized. Production increased accordingly.

The notable increase in production in recent years (1919-24) has not been due to an increase in the number of orchards. Local authorities agree that few orchards were planted in the past fifteen years, and the decrease in the number of trees shown in Table I verifies their statements. A considerable number of orchards have been planted recently, but as yet they are too young to affect production. The increase in production, therefore, should be attributed to a better performance by the orchards both in the total yield and in the percentage of trees producing. It is related also to a series of favorable seasons since 1919.

With the exception of the sharp differences in yield between 1910 and

1911, and between 1918 and 1919, production from year to year within each of the periods has been fairly uniform. Since 1918 the yield has been intermediate in regularity between that of the irregular production of New York State and that of the nearly uniform performance of the orchards in Washington.⁷ On the whole this generalization holds for the entire record of these three areas. It should be understood, however, that regularity of production as applied to any fruit district is only a relative term. It is applicable to this Nova Scotian apple district chiefly because, even in years of lowest yield, a considerable crop is produced. The import of this fact is accentuated when the small size of the Annapolis-Cornwallis District is remembered. The district is so compact that in most instances a spell of unfavorable weather affects all of it. This is not true to the same extent of New York, in which there are two important producing districts, viz., western New York and the Hudson Valley, far enough apart to have some degree of variation in weather. Thus in 1918, when the crop in the Hudson Valley was small, the crop in western New York was large, while in the following year the opposite was true.⁸ Nova Scotia production, as has been stated, rests principally upon the performance of the orchards in the Annapolis-Cornwallis District. With the possible exception of 1918, when no record was kept, the orchards in the district have produced at least 600,000 barrels every year since 1911, and in the past six seasons they have averaged 1,864,000 barrels.

In view of the small size of the producing area this record means that a majority of orchards bear a crop in most years, while many of them produce practically every season. Such regu-

⁷ Beginning in 1918, the record in thousands of bushels has been for New York, 14,350, 47,087, 13,500, 36,000, 24,000; for Washington, 29,295, 21,502, 29,062, 25,775, 31,357; *Yearbook*, Dept. of Agric., 1923, p. 731.

⁸ *Tariff Information Surveys*, United States Tariff Commission, 1921, p. 19.

⁵ Eaton, R. S.: "The Outlook for Fruit Growing," *ibid.*, pp. 5-9.

⁶ *Ibid.*

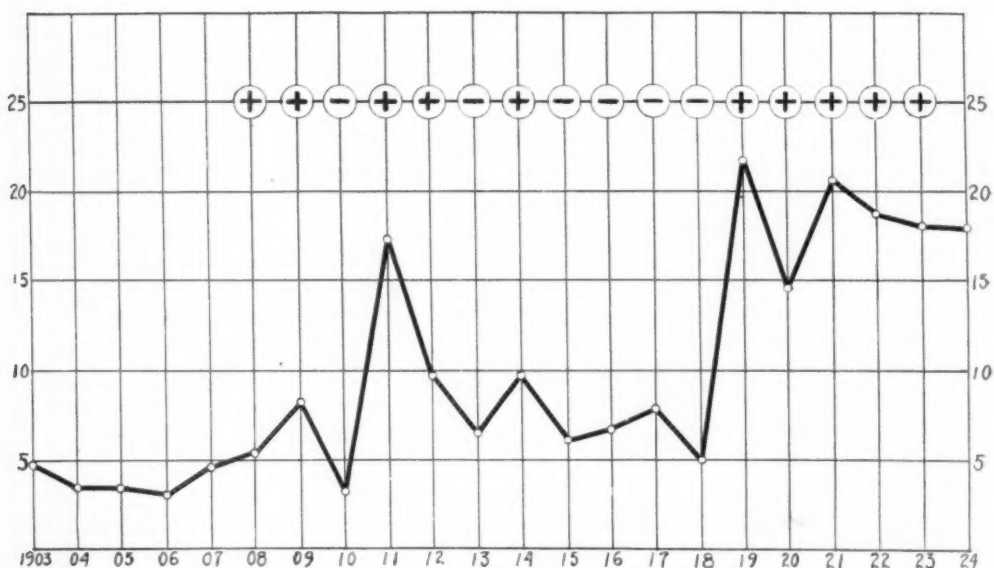


FIGURE 4.—The curve illustrates the trend of apple production in Nova Scotia from 1903 to 1924 inclusive. Figures for the first ten years are from the annual report of the Fruit Growers' Association of Nova Scotia, 1919, p. 44, for the other years from the United Fruit Companies of Nova Scotia, Limited. The plus and minus signs indicate seasons of favorable and unfavorable weather, respectively. It was found impracticable to "characterize" the weather for the years from 1903 to 1907 inclusive.

larity of production attests the general suitability of the climate of the district. It reflects a distribution of orchards within the area which capitalizes the sites combining the requisite drainage, soil, and slope. It is an outgrowth of long experience in apple culture, which now represents a regional asset. It means the widespread use of orchard practices which stimulate yield and produce a satisfactory pack. Finally, it has developed under the spur of a regular demand for the varieties and the quality of apples which the district produces.

PRODUCTION AS RELATED TO CLIMATE

Apple culture in the Annapolis-Cornwallis Valley is closely related to climate both as to general success and as to fluctuations in volume of production. In general, apple culture flourishes in the climate of this valley. Winter killing is rare, the normal blossoming time is late enough to minimize damage from frost, the growing season is adequate in length and has the conditions requisite

for maturing the fruit, and under the autumn conditions the fruit usually can be picked and packed efficiently. Extremes of heat, cold, wind or rain seldom occur. The climatic factor is positive rather than negative. During the sixteen years from 1911 to 1924 inclusive the ratio of favorable to unfavorable years is 10 to 6 (Fig. 4). Moreover, two of the years classed as unfavorable probably would have been called favorable in many fruit districts. The facts on which the seasonal generalizations are based are listed in the following Table II. A close relation exists between the nature of the season and the volume and quality of the crop. Thus the large production from 1919 to 1924 inclusive was associated with a series of favorable seasons, while the small volume of the crop from 1915 to 1918 inclusive was due to the occurrence of unfavorable weather at some critical stage in the development of the fruit or at harvest time. The sharply contrasted yields of 1910 and 1911 are explained by equally sharp contrasts in the character of the seasons.

The abnormally low yield of 1910 occurred in one of the most unfavorable seasons on record, while the conspicuously large crop of 1911 marks a season of nearly ideal apple weather (see Table II, 1911).

WEATHER HAZARDS

The record in Table II shows that the amount and quality of the crop are closely related to the character of the weather at certain periods during the growing season or during the preceding season.⁹ The most critical period is late in May and early in June immediately before and during the time when the

⁹ See also Shaw, P. J.: "Fruit Growing in Nova Scotia," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, p. 9.. Professor Shaw is provincial horticulturist and professor of horticulture at the Agricultural College at Truro. His reports and papers in the annual reports of the Secretary for Agriculture, constitute the most authentic source of material on the Nova Scotian fruit industries. The writer is indebted to him for numerous courtesies during a reconnaissance of the area in 1922.

trees are in blossom. Then the buds may be killed by a late anticyclonic frost, or the pollenization of the fruit by the work of bees may be prevented by cool, cloudy, rainy weather, especially if unseasonably warm weather in May has advanced the buds unduly. Thus in 1910, 1913, 1914, 1918 and 1921 frosts injured the buds or blossoms. Furthermore cool, damp weather increases the danger from fungus, and sprays applied at such times may cause damage to the leaves and fruit.¹⁰ Such conditions occurred in 1913, 1915, 1916, 1917 and 1918 (Table II). Years with dry, clear weather during blossom time, as in 1911, 1919, 1920, 1921 and 1922, are favorable to pollenization and unfavorable to the development of black spot, a fungus which in some years greatly damages the fruit.

¹⁰ Sanders, G. E.: "Apple Spraying in 1919," *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, p. 112.

TABLE II

Weather Conditions Affecting the Production of Apples in Nova Scotia from 1908 to 1923 Inclusive *

- 1908 Favorable season. Year has been a good one for fruit grower. Crop large and of good quality.
- 1909 Apparently a favorable season.
- 1910 Unfavorable season. Dry weather during latter part of growing season of 1909 when fruit buds were forming. March and April of 1910 unseasonably warm, advanced development of buds by three weeks. Three-day freeze late in April, killed blossoms before they were opened. Frost on June 5 injured trees when they were in full bloom. Cold, dull and rainy weather during blossoming period interfered with pollenization.
- 1911 Favorable season, large quantity, high quality. Dry weather in June and July prevented any serious development of apple scab. Enforced rest of many orchards in 1910 was chiefly responsible for large yield of 1911. Also due to greater care. More orchards were fall-plowed in 1910 than usual, partly because there was more time to spare from harvesting.
- 1912 Favorable season. Quality reduced by black spot, especially true of Gravensteins.
- 1913 Unfavorable season. Warm weather of early spring followed by heavy frosts, injured buds. Much cold, wet weather during blossoming period. Frosts in August and September. High prices resulting from world shortage offset small crop.
- 1914 Favorable season except that heavy frost on June 3, when trees were in full bloom, reduced total crop by a third or more. Low areas, and sandy sections in middle of fruit district suffered most. Exceptionally favorable weather in October gave farmers opportunity to harvest their large crop of apples to advantage. Quality high. Price low.
- 1915 Unfavorable season. In June orchards gave promise of full crop, but crop was much reduced by heavy drop in July, owing to wet weather black spot developed abundantly, especially in unsprayed orchards. Season cool and moist.
- 1916 Unfavorable season. Blossoms late in opening, no frost injury observed. Eleven dull or rainy days during first two weeks of June, when trees were in blossom. September favorable for gathering Gravensteins. Fruit colored well, not large, but reasonably free from disease.

*Based on the annual reports of P. J. Shaw, Professor of Horticulture at the Nova Scotia Agricultural College, to the Secretary of Agriculture, *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1910-23, and on reports of W. S. Blair, Supt. of Dominion Experimental Farm at Kentville in *Census and Statistics Monthly*, Department of Trade and Commerce, 1912-1916 inclusive, continued in the *Monthly Bulletin of Agricultural Statistics*, *ibid.*, 1917-1924 inclusive.

TABLE II—Continued

- 1917 Unfavorable season. Cold and wet spring delayed blooming two weeks later than normal. No damage from frosts but weather continued cold and backward until July. Black spot developed accordingly. Rain unfavorable for spraying. Heavy gale on August 10 blew off fully 20 per cent of apples in main part of fruit district and about 75 per cent in Digby and Yarmouth counties. Fine, dry weather in September developed high color in apples, the quality being correspondingly improved. Severe gale on October 30 uprooted some apple trees. First week of October was fine, giving ideal conditions for packing apples.
- 1918 Unfavorable season. Fine weather of May brought trees into bloom earlier than normal. Damaging frost on June 21. Frost occurred in every month. Nearly half of the weather during May, June, July and August was dull and cool. Blair states that June was a bright month, only four days being without bright sun.
- 1919 Favorable season. Weather during bloom, except in case of Gravensteins, was favorable. Cold, north winds and dark days during last week in May favored apple spot and trees not sprayed early show a considerable amount of this fungus. Weather during October, as usual at this time of year, has been wet, precipitation totalling 3.93 inches and occurring on 15 different days. These conditions have seriously interfered with proper gathering of fruit. Severe frosts on 21st affected keeping quality of unpicked fruit and necessitated marketing it without delay.
- 1920 Favorable season. Some winter killing of fruit trees and of scions set in 1919. Spring was unusually dry, with fairly good weather at blossoming time for pollenization of apples. Later blossoming varieties had less sunshine. Heavy frost on May 31. Conditions have been ideal for harvesting apples, and the proportion of No. 1 quality is greater than usual.
- 1921 Favorable season. Driest season in years. Weather favorable for control of black spot, crop comparatively free from this disease. Spring was early. Frost May 24 damaged fruit. Most damage from frost to orchards in apple district occurred on south side of Annapolis Valley. Little or no injury on north side where an unusually good crop was harvested. South side also suffered from drought and high winds in August and September. In past the central part of the valley always has suffered most from unfavorable weather. Heavy drop of apples late in June, which Blair attributes to dry condition of soil. Frosts in October caused a large loss of apples.
- 1922 Favorable season. Dry period in June at blossom time tended to prevent development of black spot while the unusually heavy rainfall during rest of season resulted in fruit of good size. Color good. Precipitation in October, 6.38 inches, recorded on 12 days, interfered considerably with picking of apples. By October 25 most of fruit was gathered.
- 1923 Fairly favorable season. Unusually cold winter, a rather backward spring, cool, cloudy growing season, mild open autumn. High winds on August 22 and October 1 damaged apple crop. Fruit lacked usual high color and quality of former years.

The quality of the apple crop is affected by the character of the summer weather. Prolonged spells of cloudy weather increase the injuries from fungi and other pests, and thus damage the quality of the crop. Heavy gales in 1917 and 1923 materially damaged the crop. The color of the fruit is better in the summers which have more sunshine. On the whole, the typical Nova Scotian summer is slightly deficient in sunshine for apple culture. The growers have overcome this handicap to some extent by selecting varieties of apples which require less sunshine. Certain varieties, such as the Winesap and Newton Pippin, practically are eliminated from culture for commercial purposes in the Annapolis District because the growing season is not warm enough to mature them properly.¹¹

¹¹ Macoun, W. T.: "The Commercial Varieties of Apples of Canada and the United States," *ibid.*, p. 119.

In most years the weather during the harvest season is satisfactory. Apparently the danger of injury from frost is slight, for the official crop reports mention damage to apples from frost during harvest only twice in the period from 1910 to 1924 inclusive. In 1922 it was claimed that the severe frost of October 21, 1919, caused the only serious damage from frost during the preceding twenty years. If the ratio of 1 to 20, or even 1 to 10, represents the long-term frost hazard, it is clear that this practical absence of damaging frost during the harvest, constitutes one of the regional assets of this industry. Autumn rains, however, in many years interfere with picking operations and in some years, as in 1919, cause considerable loss.¹² If open barrels of fruit are left in the orchards during a protracted rain, both the fruit

¹² Vroom, G. H.: "Points on the Packing and Handling of Apples," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, p. 170.

and the barrels may be damaged. In any case the rain causes the farmer considerable extra work and expense. The average October rainfall at Kentville in the interval from 1914 to 1923 inclusive was 4.23 inches. Table II shows that in 1919 showers were recorded on fifteen different days, and on eleven days no sunshine was recorded. These conditions seriously interfered with the proper gathering of the crop. Somewhat similar reports appear in 1922, while in other years, notably 1914 and 1921, "ideal weather for harvesting the apples" is reported. As the weather has a direct bearing upon the progress of the harvest, and as the success with which the apples are picked is related closely to the amount of fruit which reaches the packing houses in condition to pack satisfactorily and, thus, directly affects the income which a grower receives from his orchard, the hazard from rainy weather during the harvest period is sufficient to be recognized as a minor handicap to this apple industry.

Apple culture in the Annapolis-Cornwallis District likewise is favored by the winter weather. The publications of the Fruit Growers' Association make little or no mention of winter killing, and the monthly crop reports from Nova Scotia make no mention of severe winter killing. There is no evidence of such severe damage as occurred in Ontario and New York in the winter of 1917-18. It is estimated that more trees were killed in that winter in Ontario and Maine than had been planted in Nova Scotia in the preceding ten years.¹³ The orchards carry through the winter in good shape and thus the district does not face the losses from winter killing which occasionally occur in some fruit districts. There is record of one tree in Kings County which in 1925 is one hundred and twenty-six years old and is bearing fruit at least every other year¹⁴ (Fig. 5).

¹³ Johnson, F. H.: Presidential Address, *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, p. 15.

¹⁴ Kinsman, J. A.: "What One Apple Tree Has Done," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1910, Pt. II, p. 49.

LOCALIZATION OF CLIMATIC ASSETS FOR APPLE CULTURE

Locally the general belief is that the Annapolis-Cornwallis Valley possesses a modification of the regional climate which makes it more suited to apple culture than other parts of Maritime Canada. It is argued that the valley has



FIGURE 5.—A bearing apple tree 126 years old growing on the side of a ravine at the base of North Mountain, near Lakeville in Kent County. This patriarch has witnessed almost the full course of apple culture in Nova Scotia. In its youth, it furnished fruit for its owner's table, in its maturity it witnessed the slow development of commercial production and about 1870 was grafted to Gravenstein, the principal commercial variety. More recently, it has contributed its quota to the rising tide of production in the Annapolis-Cornwallis Valley. In 1899 its owner wrote, "It is not cultivated in any way, nature having provided everything that is wanted for this tree." Thus it testifies to the natural capacity for apple culture possessed by this valley. (Photo by A. L. Hardy, Kentville.)

fewer severe frosts at critical periods, has less likelihood of cold, wet, cloudy weather during the blossoming period, has more sunshine throughout the summer and is more protected from high winds than other areas in the region.

Generally these advantages are attributed to the maritime position of the peninsula of Nova Scotia, to the trough-like structure of the valley, and to the "protection" offered by *North Mountain*.¹⁵ Unfortunately crop and weather records do not exist in sufficient detail from enough places in the region to test the truth of this claim satisfactorily.¹⁶ Therefore, in some instances it is difficult to lift the contention above the level of personal opinion.

The claim that the Annapolis-Cornwallis Valley has climatic assets for apple culture not enjoyed by other areas in the region is supported by the absence of commercial orchards in Prince Edward Island. Experience has demonstrated that in this fertile province, which is almost a replica of the Annapolis-Cornwallis Valley in underlying rock, topography, soil, and drainage, apple culture on a commercial basis is impractical. On account of the prevalence of floating ice in the Gulf of St. Lawrence in late spring, the growing season in most years opens too late and is too cool and foggy for apples. In evaluating this evidence it should be borne in mind that until 1917 produce from Prince Edward Island could not be shipped to the mainland by rail, for only when the exigencies of war made it imperative, was car-ferry service inaugurated across Northumberland Strait. Even as recently as 1922 railroads in the island were not completely changed to the standard gauge.

The question of the success or failure of apple culture on a commercial basis in other sections of Maritime Canada, and the generally accepted belief that the

climate of this district really is more favorable for horticultural activities than neighboring districts, are receiving the convincing test of practical experience in a number of places in the region. An outstanding case is in the Fredericton section of the St. John Valley in New Brunswick, where a number of young, thriving orchards and an increasing apple production will demonstrate in time whether apples of good quality and in considerable quantity can be produced with sufficient frequency to warrant specialization in this fruit. If these orchards are damaged or the crop decreased in quantity or quality by weather more frequently than those in the Annapolis District they will be under a considerable handicap. In New Brunswick it is claimed that well managed orchards on proper sites in the St. John Valley are no more handicapped by climatic conditions than similar orchards in the Annapolis District.

As far as climate is concerned, the western sections of Nova Scotia apparently are better equipped for apple culture than the eastern sections. The evidence rests in part on the continued success of the industry in the Annapolis-Cornwallis District and in a few other areas in the western part of the province, and in part on a provincial experiment with model orchards authorized by an act passed by the legislature in 1901. "The object of the act was to discover what sections of the province outside of the present fruit district are adapted to fruit-growing; what varieties are best suited to these parts, and by illustrations of the right method of culture, to encourage those who are living where fruit may be grown to engage in the industry."¹⁷ Under the terms of the act the Department of Agriculture entered into an agreement with a farmer in each of the localities selected for the experiment. As nearly as practicable the farmers followed recommended orchard practices and in return received a small grant from

¹⁵ Shaw, P. J.: *op. cit.*, 1916, p. 3.

¹⁶ A letter from Sir Frederick Stupart, Director of the Meteorological Office of Canada, quotes a memorandum from the Climatologist of the office as follows:

"There has been for a long time a generally accepted belief that the climate of the Annapolis Valley is really better than that of the adjoining regions. The averages of rainfall and temperatures support this belief to some extent. The observations, however, ought to be examined in detail, frequency tables of certain ranges of temperature and precipitation during various epochs of growth being made."

¹⁷ *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1912, pp. 26-34.

public funds. The agreements covered a period of ten years, and at the end of that time were renewed for a similar interval. Two or three model orchards were established in each county and thus were so widely spaced in the province (Fig. 6) that their record constitutes a real test of the performance of tree fruits in eastern and western Nova Scotia. Writing in 1923, when the agree-

water in Lunenburg County. At Caledonia, all farming activities were handicapped for many years because the district had no railroad outlet. After a railroad was built into it, more attention was given to farming and in 1913 a coöperative fruit packing company was organized and a warehouse constructed.¹⁹ Apparently apple culture is successful in in these districts, the limitation to its extension being the relatively small acreage of tillable land rather than the nature of the climate.

If the contention be true that the orchards in the Annapolis-Cornwallis valley are climatically favored on account of its trough-like structure, orchards should thrive less well on the summit and northern slopes of North Mountain than in this valley. One of the best informed growers in the district inclines to the opinion that if orchards now growing on North Mountain were given the same care, they would produce as well and as regularly as those in the valley. This theory is not likely to be verified experimentally in the near future, for even if orchards did bear well, it is probable that the long haul to shipping points in the valley would render apple production relatively unprofitable.

PRODUCTION AS RELATED TO ORCHARD SITES

The Annapolis-Cornwallis Valley is not and never has been a district of continuous orchards. Such statements as "one may ride for fifty miles under apple blossoms," which by certain writers have been applied to the valley, are literally untrue and figuratively unhappy. In riding along the country roads, a casual observer gains an exaggerated impression of the amount of land devoted to orchards, for the time-honored practice of placing the orchards near or about the farm homes has been followed rather consistently. Likewise looking into the Cornwallis Valley from this position on



FIGURE 6.—Distribution of Model Orchards in Nova Scotia. These orchards represent an attempt, carried through two decades, to ascertain the sections of the province suited to fruit culture. Each dot shows the location of a model orchard.

ments on twenty of the orchards had expired, the provincial horticulturist concludes that "in central and eastern Nova Scotia the Model Orchards have clearly shown that the natural conditions of some localities are not suited to the growth of tree fruits," and that "the Model Orchards in western Nova Scotia have demonstrated that the location in nearly every instance is suited to fruit growing, especially apple culture."¹⁸ The experiment carried now through twenty years represents a notable and apparently a successful attempt to adjust an industry to the natural environment.

In western Nova Scotia commercial orchards now exist outside of the Annapolis-Cornwallis Valley. Apples are raised commercially in the farming communities centering at Caledonia in Queen County and at New Germany and Bridge-

¹⁸ *Ibid.*, 1923, pp. 68-71.

¹⁹ Smith, Josiah: "Apple Growing in North Queens," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, p. 150.



FIGURE 7.—Looking south from North Mountain across the Cornwallis Valley with South Mountain in the distance. The foreground is in the vicinity of Lakeville in Kent County. The valley at this point is about eight miles wide. (Photo from A. L. Hardy.)

South Mountain or on North Mountain, as in Figure 7, the impression is gained of closely spaced orchards, for the orchards are most numerous along the valley slopes. In fact, however, orchards probably occupy less than 15 to 20 per cent of the slopes and floor of this valley. Moreover, the total orchard acreage in Nova Scotia, as stated in the census of 1921, is not more than 20 per cent of the total area of this apple district. The explanation of the relatively small amount of land devoted to orchards is that not all of the land in the valley is suited to orchards, that as yet orchards do not occupy all of the sites in the valley suited to their culture, and that not all of the farmers owning suitable land are convinced of the wisdom of specializing in apple culture as a long run proposition.

Because orchards of some size and of some degree of productiveness are growing in a considerable diversity of drainage situations, in varieties of soil from heavy clay to sands, on various slopes, and at many elevations, generalizations concerning the distribution of orchards must possess a considerable degree of

inaccuracy. However, the sites best adapted to orchards have become recognized by the slow process of practical experience. They have been revealed by the paying orchards, those which represent a commercial asset to their owner. A statement which approximates the truth is that with proper management, orchards in this area thrive best on sites which possess three qualifications: (1) adequate drainage, (2) a soil and subsoil which, while gravelly enough to permit of good drainage, contain sufficient fine materials to retain a requisite amount of water, and (3) sufficient slope to afford air drainage on frosty nights during critical periods. Such sites occur in many places on the floor of the valley, along the slopes of North Mountain, and particularly along the lower slopes of South Mountain. They are entirely absent on the intervalles of the streams and on the dyked marshes near the bays. As it has taken years to develop the present knowledge of orchard location and as it requires from fifteen to twenty years to bring an orchard to bearing in a commercial way, it is probable that some orchards

were located years ago on sites which would not be selected at present. Conversely, farmers owning land so unsuited to cereals and forage crops that formerly they scarcely were able to make a living from mixed farming, through the establishment of orchards, have risen to prosperity on the high tide of success which in recent decades has characterized the apple industry.

IMPORTANCE OF WELL-DRAINED SITES

The apple orchards in the Annapolis-Cornwallis District in most instances are located on well-drained sites. The importance of adequate drainage for apple production is widely recognized. As one of the leading orchardists of the area expresses it, "apple trees must not have wet feet." This means that the orchards do not thrive in situations where the drainage is sluggish or where the ground-water table is near the surface. The presence of a large number of orchards along the slopes of North and South mountains is in part a reflection of the excellent drainage of those slopes. On the valley floor, practically all of the orchards are at an elevation of at least from fifty to one hundred feet above the major streams, and most of them are on the well-drained crests and gentle upper slopes of low hills. Such hill sites are

numerous in this district, for the valley floor has a vague relief pattern of low irregular hills and shallow depressions imposed on the underlying friable sandstone by a combination of glacial deposition and marine sedimentation. Few if any orchards occupy the depressions and practically none are planted in the intervals and dyked marshes. Such lands in many instances require ditch or tile drainage before even hay, oats or root crops can be grown, and therefore are unsuited for apple culture. The distribution of orchards shown in Figure 8 is typical. The orchards in the foreground are on the well-drained lower slopes of North Mountain, while those in the middle distance are on the slopes and crests of low hills. That the elevation of these hill sites is sufficient for adequate drainage is evidenced by the steep cliff face exposed on the far side of the small inlet in the foreground. The view illustrates the fact that orchards by no means occupy all sites suited to them. Thus there are on both sides of the inlet considerable acreages of well-drained land which are devoted to general farm crops. In addition, such crops typically are grown in the less well-drained bottoms of the broad shallow glacial depressions, of which the farmed area beyond the round-roofed barn on the far side of the inlet is



FIGURE 8.—The shore of Minas Basin from Lookoff Point on North Mountain. (Photo by A. L. Hardy.)

an example. The dyked marsh which shows clearly at the extreme right of the picture illustrates the type of land entirely unsuited for orchards.

PREVALENCE OF SATISFACTORY SOILS

As far as soils are concerned, apples do well throughout the district except on the heavy loams of the intervalles and upon the compact silt loams and heavy clays of the dyked marshes. Even on such soils the sluggish drainage and high water table probably constitute the more important part of the negative relation. Moreover, these marsh soils when properly under-drained have produced without fertilizer, profitable crops of hay for decades. This Broad Leaf hay is used extensively for cattle feeding and, since it is produced at low cost, constitutes a local resource of great importance.²⁰ Therefore the farmers fortunate enough to own such land probably would not devote it to orchards even if apples would do well on it.

Elsewhere in the Annapolis-Cornwallis District the soils in general are fine, friable and loamy, and are well suited to the two cash crops, apples and potatoes.²¹ Such soils are widely spread in the valley, occurring characteristically on the low elevations on which the orchards are located, where the gravelly nature of the subsoil, combined with the elevation, insures active drainage. Moreover, this subsoil contains sufficient fine material to hold some water and to permit "a moderate capillary flow of ground water to the surface." Such a combination constitutes what the orchardists term an ideal orchard site.²² The fact that such sites are numerous throughout the valley constitutes one of the basic assets of the apple industry. Before the introduction of apples and potatoes as money crops, many of these sites were of relatively low

value because they are not as well suited to cereal and forage crops as are the intervalles and dyked marshes. Consequently the orchards, particularly those on the slopes of South Mountain and on the sandy areas in the vicinity of Berwick and Waterville (Figs. 2 and 9) have not encroached materially on the hay and cereal lands, but instead have developed either on land not really suited to such crops or on areas not previously cultivated. The development of the apple industry, therefore, has widened the utilization of the land and has added greatly to the wealth of the district. On the valleyward slopes of North Mountain, orchards are not as numerous as on the slope of South Mountain. Locally this condition is attributed to the fact that the soils on North Mountain are heavy loams, being derived from the slaty trap rock of which it is composed, and therefore they are fairly satisfactory for cereal and fodder crops.²³ (Fig. 10).

IMPORTANCE OF SLOPE POSITIONS

Orchards placed on the higher hills of the valley floor, and especially on the slopes of the mountains, are less likely to be damaged from frost than those in lower situations, because on a frosty night the cooler air slowly settles into the low areas, thus maintaining some air movement on the hill slopes (Fig. 11). Damaging frosts occur in some years during or immediately before the time when the trees are in blossom. Experience has demonstrated that frosts at such times are more destructive on the low lands than on neighboring hill slopes and also that they are more destructive on low hills near the center and lower parts of the valley than along the slopes of the bordering mountains. The practical result is that orchards located on sites where air drainage on a clear, quiet, frosty night is active, produce apples in more years than do those in situations where the opposite is the case. Naturally, this differentiation among orchards otherwise equally well placed is reflected

²⁰ Cumming, M.: "Geological Formations and the Soils of Nova Scotia," *Ann. Rept. of the Sec. of Agric., Nova Scotia*, 1915, Pt. III, pp. 13-14.

²¹ *Ibid.*, p. 12.

²² Blair, S.: "Orchard Cultivation," *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, p. 19.

²³ Cumming, *op. cit.*, pp. 12-13.



FIGURE 9.—The floor of the Annapolis-Cornwallis Valley in the vicinity of Berwick in Kent County. The foreground is one-and-a-half miles south of Waterville with the camera pointed southwest. The divide between the Annapolis and Cornwallis rivers is in the middle distance at the right. The orchards may be identified by their definite pattern. Many farmers in this section have specialized in apple culture to the point where their orchards represent their principal economic interest. The forested patches are the wood-lots of the farmers. (Photo by the Royal Canadian Air Force.)

in the profits accruing from orchard operation. It is known that not infrequently well cared for orchards in the center of the valley have failed to yield a crop when less well cared for orchards on higher sites have produced good crops.²⁴ Such occurrences, naturally, in the long run handicap the orchardists in the former situation. The result may be more drastic than at first appears. In seasons when the weather is favorable all of the orchards produce abundantly, while in years when the weather is unpropitious, as in 1910, 1913, 1915 and 1916, only the orchards on the favored sites produce. Not infrequently when production is

large in the Annapolis-Cornwallis Valley, the crop elsewhere is large and, in consequence, the markets are flooded and prices run low. Thus poorly placed orchards may produce mainly in seasons when low prices prevail while well placed orchards, producing at least a partial crop every year, may return a sizable profit at times when production in general is low and prices high (see Table II, 1913). As a result of this differentiation in the regularity of production and of financial return, farmers living in the lower portions of the valley customarily operate their orchards as one phase of mixed farming, especially in view of the fact that in most cases their farms include some intervale or dyked land regularly producing hay. On the other hand,

²⁴ Shaw, P. T.: "Fruit Growing in Nova Scotia," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1915, Pt. III, pp. 9-10.

farmers operating land more favorable to apple culture, because of their larger profits from apples and because in many cases their farms do not include land suited to cereal and fodder crops, devote a greater percentage of their land and a greater proportion of their attention to their orchards.²⁵

the land is too steep for effective cultivation, and where in addition the coarse, sandy, stony soils are unsuited for cereal or hay production. Under the former régime of mixed farming not much of this land was cultivated and that which was, produced little. The farmers were so poor and their buildings so ill-kept

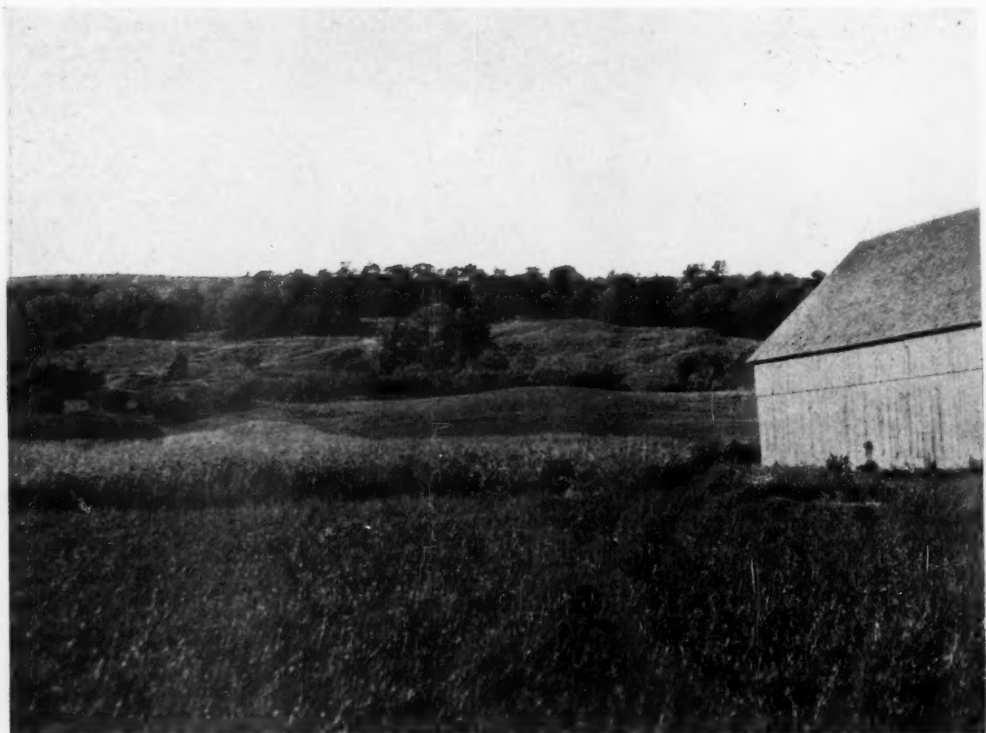


FIGURE 10.—Cropped land and orchards on the slope of North Mountain west of Berwick.

THE VALUE OF PROPERLY SITUATED ORCHARDS

An illustration of the economic rejuvenation of a community through the selection of a crop suited to the nature of the land and of the specialization of certain farmers in apple culture, is the story of "Poverty Road," near Berwick (Fig. 9). This road lies near the lower slope of South Mountain, where some of

that the section was called Poverty Road by the more prosperous farmers operating lands better suited to cereal and fodder crops. After the development of transportation to overseas markets brought apple culture to a commercial basis, orchards were planted in this section. Located, as they are, on sites possessing the requisite conditions of slope, drainage and soil, and possessing at the outset the additional advantage of low evaluation, these orchards proved successful, and today much of the land along Poverty Road is occupied by thriving orchards and owned by prosperous farmers. Probably at no other place in

²⁵ The latter group is much the smaller. It should be understood that a generalization of this type is not based on any numerical classification of farming operations. It represents the opinion of the growers as recorded in local publications and the concept which the writer gained in a reconnaissance of the district.



FIGURE 11.—Well-placed orchards on the slopes of Gaspereau Valley in Kent County. (Photo by A. L. Hardy.)

the district is there a greater degree of specialization in apple culture than in this section. Thus in approximately three decades, as the result of the discovery of a crop which capitalizes the productive elements of these well-drained sandy slopes, land of little or no value has attained a valuation reputed to be equal to that of any farm land in the Annapolis-Cornwallis Valley.

CROP ASSOCIATIONS IN THEIR RELATION TO THE NATURE OF THE LAND

Although apple culture is without question the center of interest in the economic activities of the Annapolis-Cornwallis District, the importance of the apple crop to the individual farmer varies from farm to farm. Some farmers give little or no attention to apple culture, others divide their attention between apples and other crops, while a few devote practically their entire effort to their orchards. Although this diversity of crop association is due in part to the special interest of the individual farmer,

it also reflects the nature of the land being farmed. In many situations the nature of the land practically dictates the crop association if the farms are operated at a profit, while in others the range of choice is greater. In general, the farmers whose operations do not include apple culture are those whose farms include principally dyked marshes or intervale meadows. As has been stated, the heavy silt and clay loams of these natural meadows are not suited to orchards and, when properly managed, yield remarkable quantities of hay. On the other hand, the farmers specializing in apples occupy sites which combine the advantages for apples and the disadvantages for diversified farming such as are characteristic of the slopes of South Mountain and the sandy areas near the divide between the Annapolis and the Cornwallis rivers. For the most part, farmers in this group plant only such field crops as are necessary to keep their orchards in shape. In the foregoing two types of situations the necessary relation between

crop association and site is so close that it represents what may be termed a geographic relationship of the first order. In the case of farms which include intervalle or dyked meadows as well as well-drained hill sites, it is practicable for the farmer to engage successfully in either mixed or fruit farming or, as commonly is the case, in a combination of both (Fig. 12). As the last named combination is representative of much of the district, the number of farmers in this class is large. Farmers operating land of this type can and do exercise an option as to the crops which they emphasize. Consequently sharp differences of opinion exist as to the percentage of land and time which it is

wise to devote to apple culture. Some maintain that a system of mixed farming combined with apple culture constitutes the best economy, others argue that any effort spent on other crops, except in so far as the raising of such crops is an essential part of efficient orchard practice, represents economic waste. These differences of opinion led to a debate at the fifty-second meeting of the Fruit Growers' Association of Nova Scotia in 1916, on the question, "*Resolved*, that the general adoption of mixed farming, by which is meant the keeping of live stock, and the raising of feed for the same, in addition to fruit growing, is in the best economic interest of the farmers of the



FIGURE 12.—Crop associations near Kentville in Kings County. The meadow in the foreground is a reclaimed tidal marsh. At high tide, water floods the stream course which cuts across the middle of the view, and were it not for the retaining dyke, much of the meadow would be under water. On the heavy clay soils of such meadows, crops of hay have been grown without fertilizer for decades. Orchards and field crops occupy the terrace and the low hills. An orchard shows on a well-drained slope beyond the level top of the terrace and another on the broad brow of the hill in the left background. A farmer owning land of such contrasted nature in most instances would have a diversity of crop interests, for his meadows are suited to hay and not to apples, while his hill-sites are suited to apples and not to hay. (Photo by A. L. Hardy.)

fruit growing counties of Nova Scotia."²⁶

Speakers for the affirmative argued that the mixed farmer has the advantage of not depending upon the return from one product for the success of his year's operation, that the manure produced by the stock reduces materially the amount of commercial fertilizer required by the orchard, that the mixed farmer is able to keep more help about him, as he has work for them throughout the year, and that the large quantities of feed, beef, and dairy products shipped into Nova Scotian cities evidence a market for these commodities.

Speakers for the negative were equally emphatic that successful apple culture demands the undivided attention and time of the farmer, that commercial fertilizers are entirely satisfactory for apple culture, that the Annapolis-Cornwallis Valley is adapted especially well to the growing of this fruit, that the value of land in orchards has increased much more rapidly than land devoted to other types of agriculture, that "our only loss in fruit growing in Nova Scotia is because we do not grow better fruit," that the reason for poor fruit is that "the people when they should be taking care of their fruit are down on the dykes sowing oats or getting something ready for the stock," and that the men in the valley who are making most money are those who are paying the most attention to their orchards.²⁷ Prominent in the debate were a successful farmer operating a mixed farm near Kingston (on the Annapolis River), and a leading orchardist from the vicinity of Berwick (on the lower slope of South Mountain and near the divide between the Annapolis and Cornwallis rivers (Fig. 2). Each of these men stood unqualifiedly for the system of farming he ably represented. Near the close of the debate a speaker said of them, "I have listened with great interest to this discussion and to the statements of what can be done in fruit growing and in mixed

farming. I met Mr. Foster and he told me what he had produced, and I wondered how it could be done. I went over and had a look at his farm. His farm is a farm that you could not convert into a whole orchard; it is a meadow farm, a lot of it, partially hay land, and he has farmed it as it should be farmed. Mr. Chute has a ridge of gravel up there that would not do for mixed farming at all. He would go under. He could not raise hay at all."²⁸ A more clear-cut recognition of geographic relationships would be difficult to find. In discussing this question of crop associations, Shaw declares that if a livestock farmer raises more than a small amount of apples, he is in reality operating two farms. Each type of farming requires expensive specialized equipment and the land devoted to the one cannot be used for the other. He shows further that, other things being equal, the type of farming economically appropriate on a farm may depend upon the presence or absence of natural hay land and pasture or of sites suited to orchards.²⁹

PRODUCTION AS AN OUTGROWTH OF REGIONAL EXPERIENCE

Two centuries and more of apple culture preceded the development of this apple industry. Apparently small orchards were fairly general on the farms in the district long before the stimulus of an overseas market directed attention to apple culture in a more serious way. The present industry, therefore, logically grew out of experience acquired by long acquaintance with apple culture. Experiments initiated by individual enthusiasts or by horticultural societies led to the recognition of the varieties well suited to local conditions and to the adoption of many of the fundamental orchard practices. In talking with the farmers and in reading the papers and reports of the Fruit Growers' Association of Nova Scotia, an organization founded in 1864,

²⁶ *Annual Report of the Fruit Growers' Association of Nova Scotia*, 1916, p. 51.

²⁷ *Ibid.*, p. 58.

²⁸ *Ibid.*, p. 70.

²⁹ Shaw, P. J.: "Fruit Growing in Nova Scotia," *op. cit.*, p. 11.

one is impressed by the grasp of apple culture displayed by the individual orchardist. Such general knowledge results from accumulated experience and long has constituted a regional asset of no mean value.

Record has it that the apple and other fruits were introduced into the Annapolis-Cornwallis District by the Acadians. Apparently the fruit flourished from the outset, for when English colonists arrived in the settlements some five or six years after the French had been deported, they found apple trees growing in the well-stocked orchards and gardens of the thrifty Acadians. The suitability of the local environment for apple culture was demonstrated by the thickets of lusty seedlings which had sprung up in near-by fields and pastures. Seedlings from these natural nurseries later were transplanted rather widely.³⁰ Subsequently some of the trees were grafted to better varieties imported from England. From time to time until the present, importations from England, Continental Europe, and America have been made by individuals or societies interested in fruit culture. Most of the importations were unsuited to local conditions, but a few proved satisfactory, and these are the varieties now being exploited.

With one or two possible exceptions all of the present-day commercial varieties were introduced by 1865, most of them being imported between 1814 and 1850.³¹ Consequently a considerable interval elapsed between their importation and their commercial exploitation. Gradually, through experience, the virtues of a particular variety and the conditions necessary to its culture became known. For instance, the Cox Orange, introduced by the Fruit Growers' Association in 1865, did not do well at the outset because it was grafted on a tree standing in heavy, undrained soil that was not suitable for it. Later it was found to do better on warm, well-drained soil.³²

³⁰ Starr, R. W.: "Varieties of Apples," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, p. 151.

³¹ *Ibid.*, pp. 151-64.

³² *Ibid.*, p. 157.

The geographic range for the apple in America is so wide and such a degree of attention has been directed to this fruit that more than two thousand varieties have been cultivated on this continent.³³ The dominion horticulturist finds "about ninety varieties being recommended by growers in different parts of Canada and the United States,"³⁴ while Shaw states that "probably less than thirty varieties are worthy of consideration in planting an orchard in this province."³⁵ He lists fifteen varieties as of importance in the export trade and recommends only a few others for home use. Apparently the bulk of the export trade is made up of not more than ten varieties. The emphasis placed on this small number reflects the experience of the growers as to those varieties regularly yielding fruit of good size, shape and color, which keep well and stand shipment satisfactorily, and which will meet the demands of the British market. One of the varieties possessing these requirements is the Gravenstein, on the quality and reputation of which much of the fame of Nova Scotia apples rests.³⁶ It was introduced into the valley in 1835, was widely distributed by 1850, and has proved so suited to local conditions that, while it is grown widely in Europe and in North America, it is said to be more at home and to give better results in Kings, Hants and Annapolis counties than elsewhere.³⁷ It is a fine-flavored apple, in great demand in Britain. Being an autumn variety, it ordinarily reaches the market at a time when the demand is active and the price high.

ORCHARD PRACTICES WHICH AID PRODUCTION

Apple culture developed as it is in the Annapolis Valley becomes a highly spe-

³³ Shaw, P. T.: "Varieties of Apples Grown in Nova Scotia," *ibid.*, p. 162.

³⁴ Marcoun, W. T.: "The Commercial Varieties of Apples of Canada and the United States," *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, p. 120.

³⁵ Shaw, P. J.: *op. cit.*, p. 164.

³⁶ Marcoun: *op. cit.*, p. 124.

³⁷ Starr, R. W.: *op. cit.*, p. 154.

cialized business. A grower must be familiar with the generally accepted orchard practices and must know how to adapt them to his orchard and site. The aim of the grower obviously is to produce regularly as large a crop of high quality apples as possible. To this end he prunes, plows, cultivates, fertilizes, sprays, dusts, keeps bees, plants a clover crop, harvests, and packs in the way and to the extent which he considers best. Each of these operations requires special knowledge and equipment and adds to the cost of orchard operation. Some of them are varied from site to site, their efficacy fluctuating from year to year and with the time of the season when and the skill with which they are done. It must be recognized that the job of the orchardist continues practically throughout the year and that it goes forward under the hazard of the weather over which the grower has no control, on a site which he can modify but slightly, and under the attack of insect and other pests. However, by the skillful handling of orchard and land the trees are kept healthy and, therefore, better adapted to withstand the ravages of pests and the vagaries of the weather. Obviously a detailed account of these orchard practices is beyond the scope of the present analysis, but certain of them which represent adaptations to the natural environment will be discussed briefly.

CULTIVATION

Commonly in these Nova Scotian orchards the land between the trees is plowed to a moderate depth as early as possible in the spring. This practice warms the soil by assisting the penetration of air and water, and thereby encourages the development of fibrous roots near the surface and the early vegetative growth of the trees, a desirable result in this northern district where apples require the full growing season. As most of the orchards are situated on well-drained sites, they may be plowed earlier than lower and less well-drained land, thus enabling the farmer to cultivate his

orchard before most of his land is ready for the plow.³⁸

Plowing, which sometimes is done in the autumn, is followed by shallow cultivation to produce a fine surface mulch, which puts the ground into shape to absorb moisture from the spring rains, conserves the moisture already in the ground, and makes the food materials in the soil more readily available for the "feeding roots."³⁹ Apparently the question of moisture in the soil and subsoil is of great significance to the success of the trees. In seasons of heavy rainfall there is sufficient moisture in the ground even without spring cultivation, but during the drier seasons this is not true. The growers, therefore, are advised not to take a chance in this matter. Experiments made in 1905 showed land plowed about the middle of May to contain in early August 15.10 per cent of moisture, while that plowed two weeks later contained only 9.49 per cent. As the trees fail to function properly when the soil moisture falls below 12 per cent, the importance of plowing and cultivating at the proper time is apparent.⁴⁰

SPRAYING AND DUSTING

The amount and quality of apples produced in an orchard in a particular season depends to a considerable degree upon the extent to which the ravages of insect and other pests are combated. Although many pests exist, it has been estimated that "probably more than 90 per cent of the fruit graded as second and third class must be so graded because of injuries from the scab fungus or the codling moth."⁴¹ In order to check the damage done by these pests the trees are sprayed or dusted at intervals during the early part of the growing season. The work is done by machinery designed for the pur-

³⁸ Blair, Saxby: "Orchard Cultivation," *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, pp. 19-20.

³⁹ *Ibid.*, p. 22.

⁴⁰ *Ibid.*, pp. 22-23.

⁴¹ Wallace, Errett: "Apple Scab and How to Control It," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, p. 63.

pose, and adds materially to the cost of producing the fruit. In large measure, the success of the operation depends as much upon the time when it is done as upon the materials used. It is recognized that the necessity of using insecticides varies from season to season and to some extent from orchard to orchard. Due to their situation some orchards have more scab than others.⁴² The spores of the scab fungus and of certain other pests do not germinate without moisture and therefore the damage done is greater in rainy years and in moist situations. As a result, there has been much difference of opinion with regard to spray programs, among orchardists in this and other apple districts. An illustration of the importance of the character of the season is furnished by the experience of the growers with a lime-sulphur spray in the period from 1910 to 1917 inclusive. Until 1908 Bordeaux mixture (a mixture of blue vitriol and lime) was the standard fungicide, but if wet weather closely followed its application, russetting of fruit and burning of foliage resulted.⁴³ About 1908 a lime-sulphur mixture tried in New York proved successful and was used widely. It was introduced into the Annapolis-Cornwallis Valley in 1910 and for four seasons was satisfactory. During the succeeding four seasons it was highly unsatisfactory, as it damaged the foliage and caused much of the young fruit to drop. As this spray gives little trouble during sunny weather, the difference in the effectiveness of the spray in the two periods was due to the fact that the seasons 1910 to 1913 inclusive were on the whole bright, warm and sunny, while those from 1914 to 1917 inclusive were more cool and cloudy than normal. These and other experiences demonstrate that a spray program successful in continental areas may not prove successful in the Annapolis-Cornwallis District, in

⁴² Brittain, W. H.: "Spraying and Dusting Experiments, 1918, *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, p. 102.

⁴³ Wallace, *op. cit.*, p. 65.

which, due to its maritime position, there is on the whole a slight deficiency of sunshine for apple culture.⁴⁴ As the result of the practical experience of the growers and of experiments by the dominion and provincial authorities, spray formulas and practices suited to local conditions slowly are being evolved.

FERTILIZERS

Much fertilizer is used to maintain the productivity of the orchards. It has been demonstrated that fruit trees take from the soil the same plant foods as cereals and other ordinary farm crops, but in larger amounts.⁴⁵ As well-nourished trees produce larger and better crops and on the whole offer greater resistance to pests and light frosts, the orchardist realizes that rather large expenditures for fertilizer are justified. The fertilizer program, like the crop association, varies according to the nature of the land. Orchards located on farms which, in addition to orchard sites, include considerable tracts of dyked lands, may be fertilized by manure, for the livestock on such farms are fed largely on hay grown on the natural meadows. These dyked lands may be fertilized at long intervals by opening them to the tides, but this practice means that for some seasons little or no hay is produced. Orchards included in farms where diversified farming is practiced, but on which natural hay is not produced, must be fertilized largely by artificial fertilizers, for the manure is used on the fields in which the cereal and fodder crops are grown. On the farms primarily devoted to apples, such as those on the slopes of South Mountain, little manure is produced and commercial fertilizers must be employed.⁴⁶

Nitrate of soda and phosphate are the

⁴⁴ Saunders, G. E.: "Apple Spraying in 1919," *Fifty-fifth Annual Report of the Fruit Growers' Association of Nova Scotia*, 1919, p. 112.

⁴⁵ Shaw, P. J.: "The Care of the Bearing Orchard," *Ann. Rept. of the Sec. for Agric., Nova Scotia*, 1916, Pt. III, pp. 128-129.

⁴⁶ Shaw, P. J.: "Fertilizing the Soil," *Ibid.*, pp. 128-31.

principal two commercial fertilizers used in the Annapolis-Cornwallis District. Because the former contains nitrogen in the form immediately available to the trees, a dressing of it commonly is applied in the spring when the trees are making their vegetative growth and the fruit is setting. Because nitrate of soda deteriorates rapidly in a humid climate, it is not practical to store it for long periods before it is used, and therefore at times in the past the farmers have found difficulty in securing sufficient quantities when they need it. Thus in the spring of 1923 certain ships bringing nitrate of soda for the order of the United Fruit Companies were delayed in unloading by unusually late ice in Minas Bay, and therefore late delivery to the farmers was made and considerable annoyance resulted.⁴⁷ In securing this important fertilizer the district is fortunately located, as ships can bring the nitrate almost into the orchards.

Basic slag from England, from Belgium, or from the steel mills of Sydney is one of the principal materials used to supply acid phosphate. The overseas supplies are imported cheaply because ships will make a low rate rather than cross the Atlantic in ballast. A small but locally important fertilizer containing both nitrogen and phosphorus is made from dried dog fish caught in local waters. Small factories operated at a loss by the Dominion Government produce a limited quantity of this fertilizer for local use.⁴⁸ The demand for fertilizers in the orchards and on the farms of the province has led to the development of fertilizer companies at Halifax, Windsor and elsewhere, the function of which is to combine fertilizer materials into a product suited to local needs.

COVER CROPS

The common practice of planting a cover crop in middle summer represents

⁴⁷ *Minutes and Proceedings of the Eleventh Annual Meeting of the United Fruit Companies of Nova Scotia, Limited* (Kentville, 1923), pp. 50, 53.

⁴⁸ Cummings, *op. cit.*, pp. 84-85.

another way in which the productivity of the orchards is increased by adapting crop practices to prevailing conditions. Shaw points out that by planting a cover crop in July, moisture is withdrawn from the soil during the remainder of the growing season, thus, to the extent to which this is true, checking the vegetative growth of the trees and inducing the wood and buds to mature for winter. Otherwise the abundant rainfall and heat of middle and late summer may cause a soft growth readily injured by a severe frost in early winter.⁴⁹ As most of the orchards are on slopes, and as much of the soil erodes easily, a cover crop prevents excessive soil wash. In addition it reduces leaching by gathering and holding soluble plant foods, adds humus to the soil, and reduces the likelihood of damage from deep freezing or from alternate freezing and thawing.

Several crops are sown as cover crops, the selection apparently being dependent, in part, upon the character of the soil on a particular site. Clover, vetch, or some other legume is preferred for soils on which such crops will grow, because of the addition of nitrogen to the soil. As in other northern sections of the Appalachians, buckwheat is employed extensively as a cover crop, for it will grow well on soils not suited to the legumes and on land poorly prepared for a crop.

THE HARVEST

Although the summer apples ripen as early as the middle of August, the harvest of the commercial varieties begins about the first week of September and continues for approximately two months. The early varieties, such as the Red Astrachan and the Duchess of Oldenburg, are only of local importance because they do not keep long enough to enter the export trade. The Gravenstein, the most important as well as the earliest of the commercial varieties, is harvested in September and makes up the bulk of the exports during the au-

⁴⁹ Shaw, P. J.: "The Care of the Young Orchard," *op. cit.*, pp. 39-40.



FIGURE 13—Bridgetown, in the lower Annapolis Valley. Orchards here are not as conspicuous a feature of the landscape as they are in the Cornwallis Valley. Along the tidal channel of the Annapolis River are fertile meadows protected by a dyke, which shows clearly on the right bank, particularly on the inside of the meander.

tumn. Other autumn varieties are the Blenheim, the Rebston, and the King, the last named being a handsome table apple of high quality which reaches the London market for the Christmas and holiday trade. These are followed by the Baldwin, Northern Spy, Golden Russet, Ben Davis, and other standard winter apples. As all of the foregoing are grown throughout the Annapolis-Cornwallis District, and as the harvest season at best is a busy time, it is considered good practice to include a number of varieties in an orchard in order that the harvest may be extended over as long a period as possible.⁵⁰

No matter how large and fine a crop of apples may hang on the trees at the be-

ginning of harvest, the size and quality of the commercial crop depends upon the way in which the fruit is picked, upon the labor available for this work, and upon the weather during the harvest period. For the most part the crop is picked by hand, as bruised fruit will not stand overseas transportation. Apparently the degree of care exercised is about intermediate between that of the carefully picked fancy box apples produced in the Pacific Northwest and the indifferent, careless pack of some of the districts in eastern United States. Considerable criticism of the methods of picking employed is voiced by packers and others, so that improvement in picking practices may be expected in the future. It should be understood, however, that the crux of the success of this apple industry lies in

⁵⁰ Shaw, P. J.: "Varieties of Apples Grown in Nova Scotia," *op. cit.*, p. 164.

selling apples in large bulk and of medium quality at a low price in the British markets. Therefore any change of method involving considerable cost must prove its worth before being adopted generally.

The apple picking and packing season creates a much greater demand for labor than exists at other times of the year. Fortunately the apple harvest comes later than most of the other crops. Wheat, if grown, is winter wheat and is harvested in July, oats come into harvest in August, while most of the hay is off the meadows by the first of September. Therefore the apple crop conflicts mainly with the potato and the other root crops. The individual farmer during this busy period augments his farm crew by one to a dozen or more men, depending upon the size of his orchard and the acreage of his other crops. A large diversified farm near Upper Canard in Kings County furnishes an illustration. In 1922, in addition to pasture and wood lots, one hundred acres of this farm were devoted to hay, eighty acres to orchards, fifty-six acres to potatoes, and six acres to cereals. As would be expected from the preceding discussion of orchard sites, such a diversity of crops is an expression of the fact

that this property includes a part of the interval of Canard River and also broad acreages of moderately rolling moraine. Apples, potatoes, butter, and pure bred cattle constitute the cash products. The farmer operates his own warehouse and in some years ships his apples. To his regular crew, consisting of himself, his two sons and from two to four farm hands, he adds from eight to ten men during the apple and potato harvests. While a farm business of this size and scope is, of course, the exception rather than the rule in the Annapolis-Cornwallis Valley, it does illustrate the demand for labor which the harvest creates. Additional work for many men and women during harvest and for some months thereafter is furnished by the packing plants. This seasonal demand to a considerable extent is supplied by fishermen from the "South Shore," principally from Halifax and the Lunenburg fishing district, where many men are released from the fisheries at this time of the year. These men supplement their income from the fisheries by working in the orchards and fields. The land on which they live yields them little. Its principal asset is its intermediate position between the fishing grounds and the Annapolis-Cornwallis Valley.

(The rest of this article, Part II, will appear in the next number of Economic Geography)

CLEVELAND: A CITY OF CONTACTS

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CLEVELAND is a city of contacts, a focus of natural highways.

The only broad, fairly level, lowland route directly connecting the coal fields of Pennsylvania, Ohio, and West Virginia, with Lake Erie and the deep water course through the Great Lakes, reaches Lake Erie at the mouth of the Cuyahoga. The highway along the lake plain which rims the southern shore of Lake Erie passes through Cleveland.

A VIEW OF THE CITY

Here, where these three routes meet at the mouth of the Cuyahoga, developed the

through-valley lowland, while large sections of swampy land intervene between the lake shore in the vicinity of Sandusky and the broad, relatively level land farther south. As for Toledo, it is a considerable distance from the coal fields. Such conditions as these gave the mouth of the Cuyahoga an advantage over other lake ports.

THE CUYAHOGA GAP

The broadest gash in the shale cliffs which rim the southern shore of Lake Erie from Vermillion River (Ohio) to Dunkirk, N. Y.,¹ occurs at the mouth of



FIGURE 1.—The crowded manufacturing district on the Flats in the Cuyahoga Valley above the Superior Street High Level Bridge. The valley wall appears at the extreme right of the picture.

largest city on the southern shore of Lake Erie, though better natural harbor existed at Sandusky, Toledo, and Fairport. The lowland approach to the lake from the coal fields of southeastern Ohio, Pennsylvania, and West Virginia connects with the lake at Cleveland. The country between Fairport and Pittsburgh is rough and unmarked by any continuous

the Cuyahoga. A low sand bluff replaces the undercut cliffs here, forming the only considerable area along this portion of lake shore where railroads readily can reach the water's edge. The Cuya-

¹Prosser, Charles S., "The Devonian and Mississippian Formation of Northeastern Ohio," *Geol. Surv. of Ohio*, Fourth Series, Bulletin 15 (Columbus, 1912, 14).



FIGURE 2.—The steep shale cliffs which extend westward along the lake front from the west bluff of the Cuyahoga Valley to Rocky River. This picture was taken at Rocky River.

hoga Valley is the largest valley connecting Lake Erie with other ways to Pittsburgh and the Ohio River country.

THE OHIO CANAL

The first marked increase in the rate of growth at Cleveland came when the Ohio Canal was opened. Cleveland secured the lake terminus of the canal because the lowland route from the coal fields meets the lake here, for the canal followed the Cuyahoga—Tuscarawas—Scioto lowland to the Ohio River. Feeder canals along the Muskingum and Mahoning—Beaver valleys linked the Ohio Canal with other coal fields.

ROUTES OF ROADS AND RAILROADS

Railroads and roads from the west and southwest follow the sandy, well-drained beach ridges which converge at the mouth of the Cuyahoga, then continue westward along the narrow lake plain and into New York State to the Mohawk and Hudson Valleys. West of Cleveland the lake plain is broad, but from Cleveland eastward it is but two to three miles in width, consequently roads and railroads here are relatively close together confined between the lake shore and the Allegheny front which in this region parallels the lake, and borders the higher and rougher Allegheny Plateau region.

Cleveland extends for fifteen miles along the lake shore, but the larger part of the community is east of the river on the fill of delta sand in the old pre-glacial valley. Here have developed wholesale and manufacturing districts, in addition to retail and residential areas. West of the river, the lake margin of the city is bordered by undercut shale cliffs, rising abruptly from the water, except where the Cuyahoga valley bottom, bordering the lake, is covered by a maze of railroad tracks, ore unloaders, car dumps, and iron ore stock piles. Beyond, to the westward, is vacant land or residences.

The Cuyahoga Valley is the notable topographic feature of Cleveland. It is intrenched 60 to 125 feet into the till and delta sand filling the valley of its pre-glacial ancestor. Blast furnaces, steel mills, lumber yards, petroleum refineries, chemical plants, and associated industries crowd the valley bottom for two miles back from the lake, because they seek here the major advantage derived from contact of lake and land traffic.

THE LAKE AND RIVER HARBOR

The harbor is located in the river and along the lake front. The river is the industrial harbor and the lake front the commercial harbor.

The river harbor is controlled by the city. The sharply meandering Cuyahoga prevents the largest ore vessels from reaching all except one of the furnace docks, although the twenty-foot channel provides sufficient depth. Consequently, several plans are being considered for straightening the river, so as to render the furnaces and steel mills readily accessible to all ore traffic.

The outer harbor extends along the lake front and is protected by breakwaters. The east basin contains docks equipped with car dumps, a Government wharf, passenger steamship piers, a lumber dock, and a plant for building concrete boats. Most of the frontage on the west basin is used by the Pennsylvania Railroad Company as an ore handling plant.

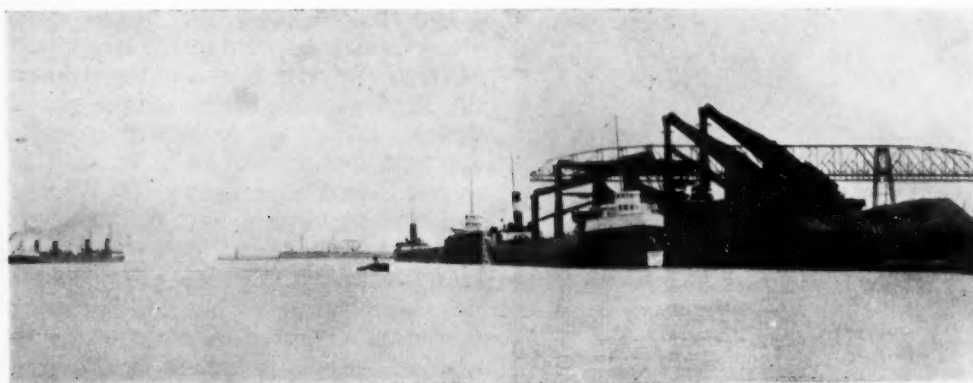


FIGURE 3.—Pennsylvania Ore Docks. An ore carrier is being unloaded, storage piles are at the right. This view is looking across the harbor eastward from the west breakwater.

The harbor at Cleveland is open to navigation nearly a month longer than that at Buffalo. Furthermore, the current of the lakes and prevailing westerly winds at the beginning and end of the winter, jam the ice floes into the lower end of Lake Erie and block the harbor at Buffalo, thus, in many cases, delaying boats for a week or more. Also, the lake level fluctuates less at Cleveland than at Buffalo or Toledo, because it is located midway between the ends of the lake where steadily blowing winds frequently pile up the water.²

THE MODERN INDUSTRIAL CITY

Cleveland is an industrial city with important commercial activities. Its manufacturing industry has become of greater value than its commerce.

The principles underlying the evolution of a city as epitomized by Brunhes have functioned markedly in the growth of Cleveland: "The concentration of habitation keeps pace with the concentration of paths of communication. The larger a city, the finer the network of roads which surround it. Inversely, the more physical conditions favor the concentration of roads at one point, the more possibilities of growth a city has."³

² *Bulletin 29*, U. S. Lake Survey Office, 32, 43, 105, 245, 317.

³ Brunhes, Jean, *Human Geography* (Chicago, 1920), 169.

CLEVELAND A MANUFACTURING CITY

Three factors appear to have been of prime importance in the development of Cleveland as a manufacturing city. (1) Cleveland is at the terminus of the best lowland route from Lake Erie to the Pittsburgh coal fields. (2) Mesabi ore can be brought by way of the lakes at low freight cost, and (3) Cleveland is located in the Northern Interior which provides a large and prosperous market for manufactured products.

In the section within a radius of 900 miles west from Cleveland, is one-third of the population of the country, half the crop production, more than one-half the value of farm land, nearly half the coal output, five sixths of the iron ore produced, and about two-thirds of the value of manufactured products.⁴ A network of steam and electric roads gives Cleveland many connections with the intensively developed area.

The manufactures of Cleveland are characterized by variety. Foundry and machine shop products, iron and steel, and industries using iron and steel, such as the manufacture of automobiles and parts, hoisting and conveying machinery, lead. Together these industries include about one-half the total value of the city's manufactures. The automobile

⁴ *Abstract of the Thirteenth Census of the United States* (Washington, 1910), 29, 365, 276, 547, 449.

industry, which requires many machine tools, is an important element in stimulating foundry and machine shop production.⁵

Cleveland is second to Detroit in the manufacture of automobiles.⁶ Fifty per cent of the steel produced in Cleveland in 1919 went directly or indirectly to the automobile and motor truck industries.⁷ The many "heat treating" processes used in these factories require large quantities

transportation facilities to the market of the Middle West, were factors in the origin and development of the ready-made clothing industry in Cleveland.

BASIS FOR VARIETY IN MANUFACTURES

Manufacturing interests in evolving this variety of activities have utilized four elements in the environment of the city. (1) The place has a favorable location for economical production of iron



FIGURE 4.—Railroads and manufacturing plants are crowded into the lower Cuyahoga Valley. A bit of the narrow winding Cuyahoga River appears at the left.

of fuel. The oil and natural gas of West Virginia and Ohio, as well as coal, are used for this purpose.

In 1914 the manufacture of ready-made clothing ranked fourth among the industries of the city.⁸ Most of the cloth is purchased from New England mills through their selling agents in New York City. However, it is probable that the local manufacture of woolen cloth from the wool of southeastern Ohio, and good

and steel. Cleveland is the chief iron and steel center on the lower lakes, because of its lowland route to the Pittsburgh coal fields. The raw material necessary to produce a ton of pig iron can be assembled for less cost in the Cleveland District, which comprises Cleveland and adjacent ports on Lake Erie, than in any other iron and steel district dependent on Lake Superior ores.⁹ (2) Lake and land traffic bring a variety of raw materials to Cleveland, such as copper, wool, grain, oil, and lumber. (3) Second-

⁵ *United States Census of Manufactures*, 1914, I, 1212-1217.

⁶ *United States Census*, *op. cit.*, 1162.

⁷ *Iron Trade Review*, Annual Statistical Number, 1920, 56.

⁸ *Census of Manufactures*, 1914, I, 1214.

⁹ Thomas, E. B., "Cleveland Harbor Problems," in the *Journal of the Cleveland Engineering Society* (Cleveland, 1915), VIII, 9.

ary industries have developed which use products and by-products of the primary industries. Some such industries are the manufacturing of automobiles, machinery, paints, chemicals, electrical machinery, electrical apparatus and supplies. (4) The multiple demands of the prosperous market in the Northern Interior also contribute to variety in products.

COMMERCE

The commerce of Cleveland is based primarily on four factors: (1) the needs of industry in Cleveland, in Pittsburgh, and in the intervening district in Ohio and Pennsylvania; (2) the key location of Cleveland relative to the market of the Northern Interior and the mineral and agricultural regions; (3) a well-developed system of land and water transportation; and (4) the contact here of areas having different types of industrial development.

Products from the farm lands of the Mississippi basin and ore from the mineral regions of large scale production around Lake Superior, at this place enter the highly developed industrial area around the coal fields in eastern Ohio and western Pennsylvania. In the decade 1910-1920, iron ore comprised 60 to 85 per cent of the lake shipments received at Cleveland. Of 11,000,000 tons forwarded to Cleveland in 1916, 4,000,000 were used in local furnaces. The remainder went to inner state and Pittsburgh furnaces.¹⁰ Cleveland is primarily a receiving port, ranking second to Buffalo.

Coal is the return cargo for the ore carriers, which do not go back to the head of the lakes "light." It is loaded at Cleveland and other Lake Erie ports, and is used throughout the Northwest as far as Montana for domestic fuel and in locomotives.

THE RAIL COMMERCE

The rail commerce of Cleveland consists chiefly of coal and coke, iron ore, iron and steel products, stone and sand, and some grain.

¹⁰ *The New Cuyahoga*, Cleveland Chamber of Commerce, 1917, 10.

Nearly all the coal entering Cleveland comes via the Pennsylvania Railroad.¹¹ Iron ore for furnaces from Cleveland to

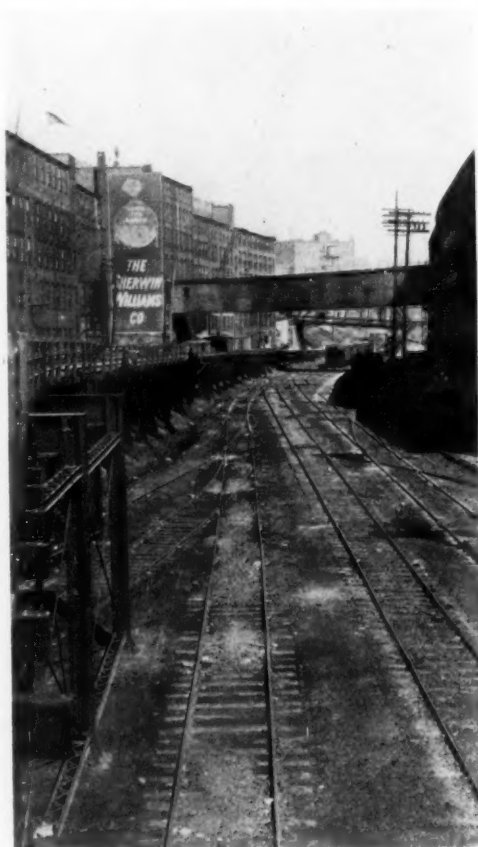


FIGURE 5.—The Baltimore and Ohio tracks here occupy the bed of the old Ohio Canal which skirted the east bank of the Cuyahoga River. The canal entered the river near the place the picture was taken.

Pittsburgh is the chief item, in bulk, moving out of Cleveland by rail. The receipts of grain at Cleveland have increased somewhat, due to the growth of the city. Now nearly all of it comes in by rail from Medina, Huron, and Lorain counties in Ohio, and the Northwest. About half of this is manufactured locally into flour for consumption in the Cleveland-Pittsburgh area.¹²

¹¹ *Green's Marine Directory of the Great Lakes*, 382.

¹² Chamber of Commerce, Inspection records for period Jan. 1916 to July 1918. Personal communication.

The railroads carry manufactured goods and merchandise in addition to bulky commodities. Goods can be packed in carload lots at the factory platform and billed through to the consignee without trans-shipment and re-packing, which would be impossible if they were sent by lake.

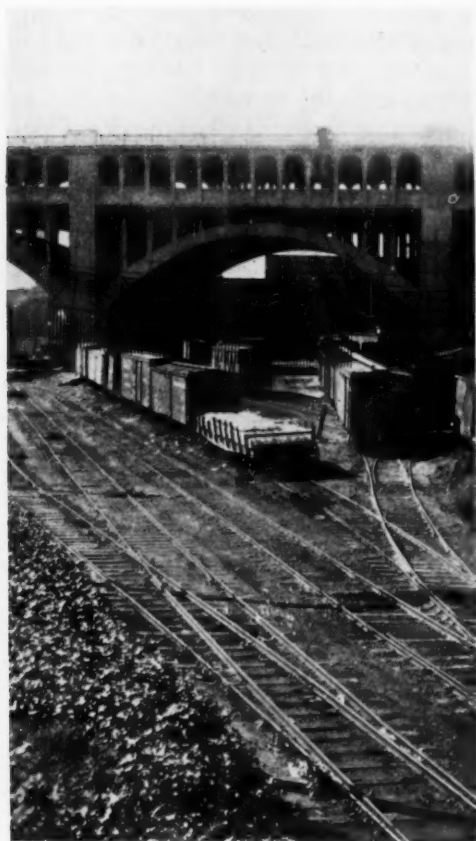


FIGURE 6.—The Superior Street High Level Bridge. Trolley cars run on the lower bridge level, and the roadway is on the top. The switchman's house near the left pier gives an idea of the height of the bridge.

RAIL TRAFFIC ADVANTAGES

The location of Cleveland within the important traffic area of the Eastern Railroad District of the United States, contributes in no small degree to the effectiveness of its rail transportation facilities, since this situation gives it direct connections with the most important producing and consuming areas in the

United States. About half the minerals and two-thirds the manufactures shipped on the railroads of the country originated in this district in 1917.¹³

Though Cleveland trades chiefly with the Northern Interior, important commercial relations also exist with all parts of the United States, Canada, Mexico, countries of South America, and other foreign regions.

Railroad traffic to and through Cleveland is predominantly east and west. It is estimated that 60 per cent of this is with the West, and 40 per cent with the East. Some of the principal commodities received from the East by rail are anthracite coal, woolens, cotton piece goods, silks, and imported goods. From the West, come lumber, grain, and grain products, building material, limestone, cement, billets, and some iron ore. The chief commodities sent from Cleveland to the East are automobiles, batteries, carbon products, clothing, shoes, steel, brick, paint, oil, and grain.¹⁴

Trade with the Lower South seems to be relatively small. Fresh fruits and early vegetables are the principal goods coming from that section. Some meat and cattle are sent in from the Southwest.¹⁵

FINANCIAL POSITION AND RELATION

The influential position occupied by the business and financial interests of Cleveland in the lake trade to no inconsiderable degree is the outgrowth of the location of the city.

When the Mesabi Mines were opened, the business of the lakes already was being directed chiefly from Cleveland. Then, all ore sales on the lakes were made here. Cleveland business men controlled all the Lake Erie Docks, except those at

¹³ *Statistics of Railways in the United States, 1917*, Interstate Commerce Commission (Washington, 1920), 9, 31.

¹⁴ Smith, W. H., Division Freight Agent, New York Central Railroad, Cleveland.

Personal communication.

¹⁵ "Internal Commerce of the United States," *Monthly Summary of Commerce and Finance*, Dec. 1911 (Washington, 1912), 953.

Buffalo and Erie, and owned 80 per cent of the vessel property engaged in ore traffic. Growth of the steel business and iron ore traffic brought about consolidation of lake ore carriers, and the coördination of passenger and package lines with the railroads. Corporations manufacturing iron and steel control the ore carrying fleets. The main offices of several of these fleets are in Cleveland.¹⁶ Together these large companies own fully three-fourths of the ore shipping on the lakes, and probably more than three-fourths of the cargo capacity.¹⁷ The headquarters of the important passenger and package lake freight lines also are in Cleveland.¹⁸

The focal location of Cleveland for manufacture of steel and handling of coal and iron which has been summarized in the preceding pages, has made it a place which business seeks, because the city has a unique position for production, and business is cumulative, for successful commercial enterprises always attract more business. The strongly developed financial interests are the logical result and concomitant of this contact location for business. The interaction of all these factors has made Cleveland the fourth city in the country in financial importance, and second only to Chicago in the Northern Interior.¹⁹

The Cleveland-Pittsburgh District produces nearly one-half the iron and steel of the country (U. S. Census of Manufactures, 1914). The iron and steel industry at Cleveland has surpassed that at neighboring Lake Erie ports, because of its significant focal location at the contact of the deep water way through the lakes with an excellent lowland route to the Pittsburgh coal fields,

in addition to a central rail location providing widely extended transportation connections. Within the city area there is a considerable extent of flat land accessible both to rail and water transportation affording favorable sites for industrial plants. These combined advantages have caused the iron and steel industry at Cleveland to surpass that at other Lake Erie ports near the Cleveland-Pittsburgh District. Semi-finished iron and steel made in Cleveland enters largely into the manufacture of finished products also produced in the city. Approximately one-half the value of manufactures in Cleveland is composed of iron and steel and goods made from these substances. (U. S. Census of Manufactures, 1914, I, 1212-1217). This important Cleveland industry includes blast furnaces, steel mills and rolling mills, wire mills, and plants manufacturing nuts, bolts, and washers. Foundry and machine shops, structural steel works, and manufacture of hoisting and conveying machinery also form significant elements in the industry. Furthermore, many industries not classed by the Census under iron and steel, depend largely upon iron and steel as materials for manufacture.

Its blast furnaces and steel mills furnish a considerable portion of the raw materials for manufacturing steel products in Cleveland. Structural steel, rails, and other products of the rolling mills are marketed all over the United States and even in foreign countries. However, these goods manufactured in Cleveland are sold principally within the northern interior. Foundry and machine shops, blast furnaces and steel mills, and in fact most of the manufacturing plants are established along the lake shore on the river flats or paralleling railroad lines.

Along with the growth in industry has gone improved physical equipment for handling products, thus enabling the city to capitalize to the utmost its natural industrial and commercial advantages. The harbor, both in the river and on the

¹⁶ Cleveland Board of Trade, *Annual Report*, 1892, 31.

¹⁷ Estimates based on figures given in the *Cleveland Plain Dealer*, April 25, 1920.

¹⁸ Conant, Luther, Jr., "Report of the Commissioner of Corporations on Transportation by Water in the United States," Part IV, *Control of Water Carriers by Railroads and Shipping Consolidations* (Washington, 1913), xiii.

¹⁹ *Chicago Daily News Almanac and Yearbook*, 1920, 774.

lake front, has been improved to accommodate the largest lake vessels and the heavy traffic movements. Railroads have built modern, well equipped freight stations on the lake and at other transportation centers in the city. The Cleveland Short Line, a belt railroad extending around the city, has brought large areas of unoccupied industrial land into contact with transportation and has connected all roads entering the city. This provides established industries with room for expansion and affords new industries advantageous location within the city.

The Federal Reserve Bank for the Fourth District is located in Cleveland. This district includes the steel center of western Pennsylvania.¹⁹ Two-thirds of the Federal Reserve Notes handled at the Cleveland Federal Reserve Bank in 1919 were received from or sent to New York Philadelphia, and Chicago.²⁰ Cleveland ranked fourth in 1919 among the cities of the country in the earning assets of its Federal Reserve Bank.²¹

The Cleveland Federal Reserve Bank has branches in Pittsburgh and Cincinnati. The combined resources of the member banks of the district occupied third place among Federal Reserve Districts.²²

THE OUTLOOK

The development of human activities in Cleveland is, in part, the economic expression of its geographical setting, for

¹⁹ *Chicago Daily News Almanac and Yearbook*, 1920, 774.

²⁰ *Annual Report of the Federal Reserve Bank*, 1919 (Washington, 1920), 100-101.

men have utilized successively various elements in the physical environment, and in turn, the city life has been shaped, in a measure, by both the favoring and retarding elements. Influences, dormant at first in so far as they functioned in city development, successively have been utilized as important assets by commercial and manufacturing interests. Possibly unused factors in the physical environment of the city are yet to be revealed, and may serve future business development, which leads one to speculate a bit as to what these latent factors may be, how they are to be used, and in what manner they will impress the character of the city.

Hydro-electric energy from Niagara Falls, 200 miles distant, may be available in the future. Whether the project of a deep-waterway-to-the-Atlantic will influence commerce or manufactures at Cleveland, if realized, cannot be determined since adequate industrial and engineering surveys, providing necessary data, have not been made.

Will Cleveland continue to be a manufacturing city? The same relations which have made it a manufacturing center should continue to stimulate its development along manufacturing lines as the contact character of its location will tend to direct it. Though other towns with steel mills and factories eventually may rim the southern margin of Lake Erie, it is likely that Cleveland will continue to be the chief manufacturing center.

²¹ *Annual Report of the Federal Reserve Bank*, op. cit., 133.

²² *Annual Report of the Federal Reserve Bank*, op. cit., 139-144.

THE INSULAR INTEGRITY OF INDUSTRY IN THE SALT LAKE OASIS

Langdon White

Economic Geographer, Clark University

THE Salt Lake Oasis, an insular concentration of human activity and business, lies in the arid intermontane basin of our West, like a verdant island in midocean, separated from the nearest shores of industry by hundreds of miles of desert, mountain crag, and canyon.

of industry was necessitated such as our land has not shown elsewhere. Individualism was suppressed in the need for community thought and action, a suppression that would have been intolerable except for the sustaining solace of the religious faith and fervor provided by the Mormon Church.



FIGURE 1.—The Farmington district between Ogden and Salt Lake City is illustrative of the insular integrity of agriculture in the Oasis. The plain is well watered and intensively cultivated with vegetables, sugar beets, corn, and alfalfa; the bench, affording excellent air drainage, is devoted largely to peaches when water for irrigation is available; otherwise, it is either planted with wheat and alfalfa and irrigated until the water supply becomes exhausted about August 1st or is left in pasture. Many of the farmers of this section live in the country.

To the geographer and economist it possesses a distinctive interest in its clear expression of the relationship between geographic conditions and industrial and economic organization, and of the impelling direction of man's activities by the circumstances of his environment (Fig. 1). Under the restrictive conditions imposed by nature, only a compact, coöperative society could prosper, and an integration

THE MORMON IMMIGRATION AND SETTLEMENT

A desolate expanse of lonely alkali flat and sun-baked plain greeted the Mormons when in July, 1847, they first looked down from the lofty Wasatch upon the plain (Fig. 2) which in good time they were to transmute into a verdant garden and a veritable hive of industry. Only roving bands of degraded

Indians and a few miserable trappers eked out a precarious existence in the valley where now a dense population and prosperous cities and towns support themselves in comfort and culture. The Salt Lake Oasis, in a single generation has been transformed from hostile desert to hospitable oasis (Fig. 3).

The region had been explored prior to the immigration of the Mormons. Two Franciscan fathers, Escalante and Dominguez, reached the shores of Great Salt Lake as early as 1776, but their journey was not fruitful of geographical discovery.¹ Captain B. L. E. Bonneville of the United States Army, while on a fur-
lough between 1832 and 1836, traded in

the region, this time from the south. His account published in 1845, undoubtedly induced Brigham Young to head his covered wagons and his hopeful disciples toward the Great Basin.

Thither they trekked from Ohio, Illinois, and Missouri to escape persecution and to find a sanctuary where they might maintain their religious integrity and set up their hearth-stones without fear of intolerant interference and abuse. They arrived in the Valley of the Great Salt Lake on July 24, 1847, and within two hours they prepared to plant crops. Because they found the ground too hard to plow easily, they built a dam, flooded the surrounding soil, and began their task



FIGURE 2.—When the pioneer Mormons emerged from Emigration Canyon in the Wasatch, they saw before them only the gray and red mountains hemming in the valley dotted with the monotonous gray and the occasional green of the desert plants. (Photo by H. L. Shantz.)

furs and explored casually in the area drained by the Bear River and its tributaries, but made no maps and left no personal record. Captain John Fremont, entering the Salt Lake Oasis via Bear River in 1842, first systematically explored it. Upon his return from California the following year, he again traversed

anew. Next morning they planted potatoes, after which they gave their tiny field a good soaking. Thus they began the extensive and successful system of irrigation, since become famous throughout the civilized world. Within a month (by August 26) the pioneers had plowed and planted almost a hundred acres with potatoes, corn, buck-wheat, turnips, peas, beans, and oats.

¹Gannett, Henry, *A Gazetteer of Utah*, U. S. Geological Survey, Bulletin 166, pp. 10-11, 1900.

The rapid Mormon immigration into Salt Lake City quickly led to the early occupation of the contiguous available arable and pasture land and forced expansion into neighboring valleys. Into every valley that his scouts reported suitable for farming, Brigham Young sent carefully selected colonists, led by efficient and experienced men of his own choosing, and of sufficient number to build forts for protection against Indian attacks and to construct dams and canals for irrigation. He located every farm village near a stream; for upon the streams the settlers depended for their very existence. In the desert water means life.

nia valleys. When these gold-seekers paused to rest and refresh themselves in the hospitable Mormon villages, they learned that the stores of supplies which they carried for the mining camps were superfluous because the demand had been anticipated and met by ocean borne merchandise; many were glad, therefore, to dispose of their impedimenta, even at great sacrifice, to their famine-stricken hosts. Thus the Mormons acquired at low cost the stores of food, clothes, and implements that they so sorely needed, and exchanged their fresh but inferior stock for the high-grade but worn and footsore animals of the travelers.

Until about 1870 the Oasis was strictly



FIGURE 3.—Water, fertile land, industry, courage, religion, and coöperation transformed the land at the foot of the Wasatch from a neglected desert wilderness to a well-tilled garden in a single generation.

The first few years of settlement were discouraging. Just when increased population began to tax the food resources of the pioneers, the Rocky Mountain locusts ate their crops and well-nigh reduced them to starvation. It was a dark time; only strength of religious faith maintained their morale. Like a golden rift in the gloomy prospect came the rush of the richly laden argonauts seeking the newly discovered gold of the Califor-

Mormon and almost wholly agricultural. The Church leaders knew that in order to colonize systematically the Great Basin, they must make of their followers an agricultural people. They realized that those who till the soil are more easily held in an organization like the Mormon Church than those who engage in other occupations. They, therefore, so discouraged prospecting that minerals were scarcely touched until 1862, fifteen years

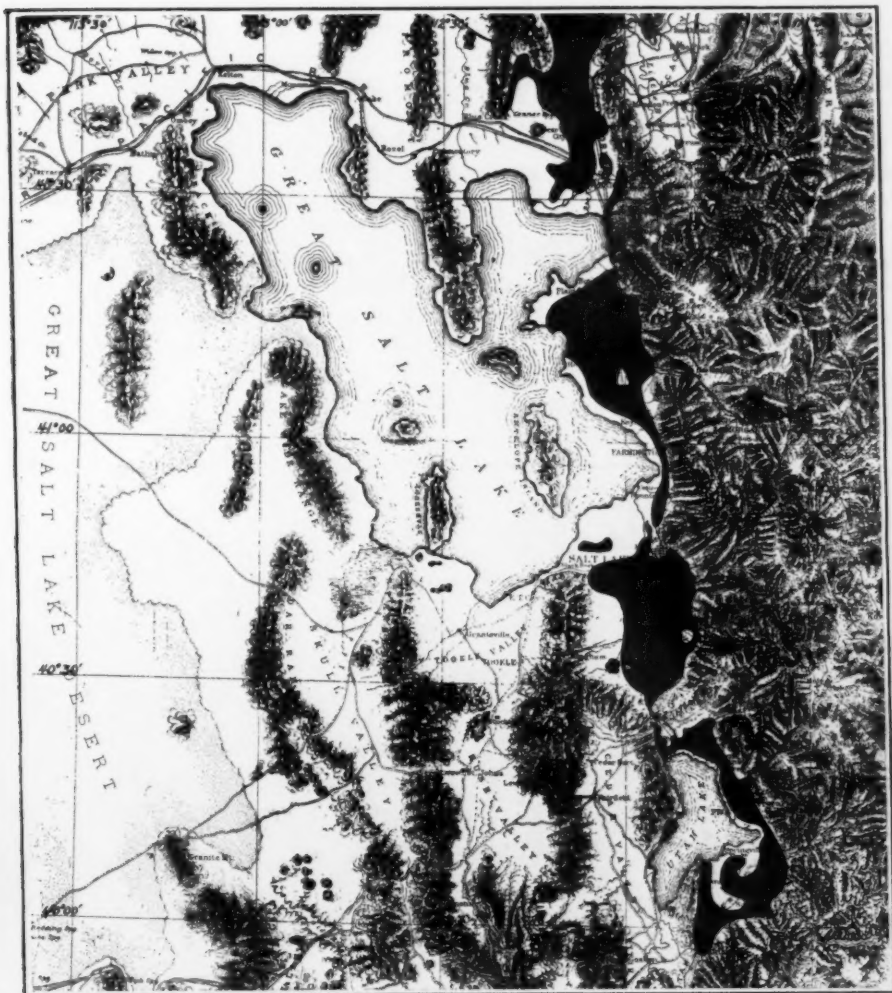


FIGURE 4.—The area in black, indicating irrigated land, is the Salt Lake Oasis; here is carried on the farming, the manufacturing, and the commerce of the region; here live nearly two-thirds of the people of Utah. The sections west of the Oasis are unoccupied and are waterlogged, alkaline, or lacking in water for irrigation. (Scale, ca. 1 inch equals 27 miles.)

after the pioneers entered the region, and then only by the soldiers who were stationed at Fort Douglas. The Mormons refrained from prospecting until the Church approved of it, following the completion of the Union Pacific Railway in 1869. With the development of the railroads and mines, Gentiles poured into Salt Lake, Ogden, and the mining and smelting centers and they became cosmopolitan and industrial. All other parts of the Oasis, however, have remained dominantly Mormon and agricultural.

THE PHYSICAL INTEGRITY OF THE AREA

The Salt Lake Oasis, an island of industry in the arid wilderness, is a distinct geographic unit (Fig. 4). This insular strip of human habitation is 130 miles long, from two to eighteen miles wide, and comprises about 680 square miles of occupied land.² At the mouth of every

² The region as physiographically defined comprises about 1300 square miles; much of this, however, is waterlogged and alkaline and consequently unoccupied.

canyon stream lies a cozy Mormon town or village girdled by green fields and adorned by orchards and shade trees. Here dwell three-fifths of the people of the "Beehive State."³

The lofty Wasatch Mountains, the westernmost of the Rockies, bound the Oasis to the east (Fig. 5). Upon them depends the economic activity of the region, because from their snow-clad slopes emerge the streams that supply the life-giving water to the thirsty plain below.

part of the Oasis, but as a part of the mountain region to the east.

Lakes, mountains, and desert delimit the region on the west. Utah and Great Salt Lakes comprise the water barriers, the desert and the basin ranges the land barriers. This entire mountain and desert area contains some important mines but has slight agricultural value. A few of the slopes are dry-farmed with wheat, but most of the land, where utilized at all for agricultural purposes, serves only as



FIGURE 5.—The eastern bounding wall of the Wasatch. In the distance is "The Point of the Mountain," where a spur of the Wasatch protrudes and nearly joins one from the Oquirrh across the valley. (Photo by C. C. Colby.)

These mountains and their high valleys differ from the Oasis in relief, elevation, climate, natural vegetation, and crops, and hence they are considered not as a

³ The state of "Deseret" meaning "honey bee" was organized in 1849 for the protection of the Mormon settlements at the foot of the Wasatch. The beehive, signifying industry, is the distinguishing feature of the seal of Utah.

winter range for sheep. Irrigation agriculture is restricted because of the small catchment basins of these watersheds. The few streams that flow from their canyons are lost by evaporation and seepage before they can be utilized.

Low hills define the Oasis on the south. They extend across Utah Lake Valley, near Santaquin, about eighteen miles

southwest of Provo, and separate it from the neighboring Juab Valley to the south. A line of sharp economic demarcation emphasizes this physiographic boundary. South of these hills is a series of north-south valleys partially irrigated and extensively tilled; north of them is the Oasis, fully irrigated and intensively tilled. The latter is characterized by small holdings, high-priced land, dense population, adequate water for irrigation and domestic use, manufacturing, fairly good markets, numerous farm villages, a

beets, fruit, vegetables, dairy products, alfalfa, wheat, and livestock, and manufacturing (Fig. 6), those in the area to the south are almost wholly alfalfa (both hay and seed), dry-land grain, and sheep and cattle (Fig. 7). Alfalfa, which occupies more than 75 per cent of the tilled land in the latter region is used as winter feed and marketed through fattened stock. The greater the distance from market, the greater the proportion of income derived from livestock, because the animals can be driven to market.



FIGURE 6.—Between the Wasatch and Oquirrh Mountains, south of Salt Lake City, is the heart of the Oasis. Here farming is most intense, manufacturing highly developed, and traffic lines most concentrated. Half way across the valley is the large lead-silver smelter at Murray.

few cities, and excellent transportation facilities; the former, on the other hand, is distinguished by an absence of practically all these characteristics. A marked contrast of farm business in the two regions is indicated by data gathered from numerous farm records during the period 1914-1916 inclusive. Whereas the sources of income in the Oasis are sugar

The northern boundary, while not so topographically evident, is nevertheless as geographically definite. South of this boundary water is "lifted" from the Bear River, which breaks into Salt Lake Valley at the "Gates" just opposite Fielding and is used for irrigation. North of this line, however, the land, because of its upslope, cannot be reached

by gravity canals, and thus necessarily precludes the possibility of irrigation agriculture. Consequently distinct systems of dry farming and stock rearing are found northward as far as Malad, Idaho, about twenty-seven miles distant, while irrigation farming in its entirety is practiced in the Oasis to the south.

are marked by a unique series of terraces (Fig. 8), which indicate the shore lines of ancient Lake Bonneville. "Through a vertical interval of 1,000 feet the story of the rise and fall of this body of water is recorded by the superposition of shore line upon lake sediment and of lake sediment upon shore line."



FIGURE 7.—Dry-land barley on the Levan Ridge, south of Nephi. For miles along this fertile but unirrigated strip at the foot of the San Pitch Mountains, one sees only great fields of grain, mostly wheat, alternating with land in fallow. Houses are lacking. The two buildings in this picture are owned by the Utah Agricultural Experiment Station. (Photo by A. F. Bracken.)

THE PHYSIOGRAPHIC UNITY OF THE OASIS

Utah and Great Salt Lake Valleys, which comprise the Salt Lake Oasis, are essentially structural troughs, somewhat continuous with those extending north and south almost the entire length of the state, but separated one from the other by low debris-covered divides. The physiographic features of these valleys are resultant upon the configuration of ancient Lake Bonneville. They are underlain by almost flat, unconsolidated lacustrine sediments, and their borders

Utah and Great Salt Lakes, remnants of old Lake Bonneville, lie respectively 4,491 and 4,210 feet above sea level. From these elevations the valleys rise to about the 5,200-foot contour, the highest level occupied by Lake Bonneville. Utah Lake, a shallow reservoir of fresh water, twenty-two miles long and ten miles wide, covers an area of about 93,000 acres.⁴ Its swampy shore line is subject to considerable variation, owing

⁴ Woolley, Ralf R. *Water Powers of the Great Salt Lake Basin*, U. S. Geological Survey, Water-Supply, paper 517, pp. 24-33, 1924.

to the changing relations of precipitation, inflow, evaporation, and the use of water for irrigation. Great Salt Lake is the largest inland body of water west of the Mississippi River, and like Utah Lake, varies in extent from year to year. Its

Oasis form the dominant topographic features of the region. The Wasatch Range to the east is a vast block of red sandstone and quartzite that has been elevated at its western margin to a maximum elevation of about 12,000 feet above tide.

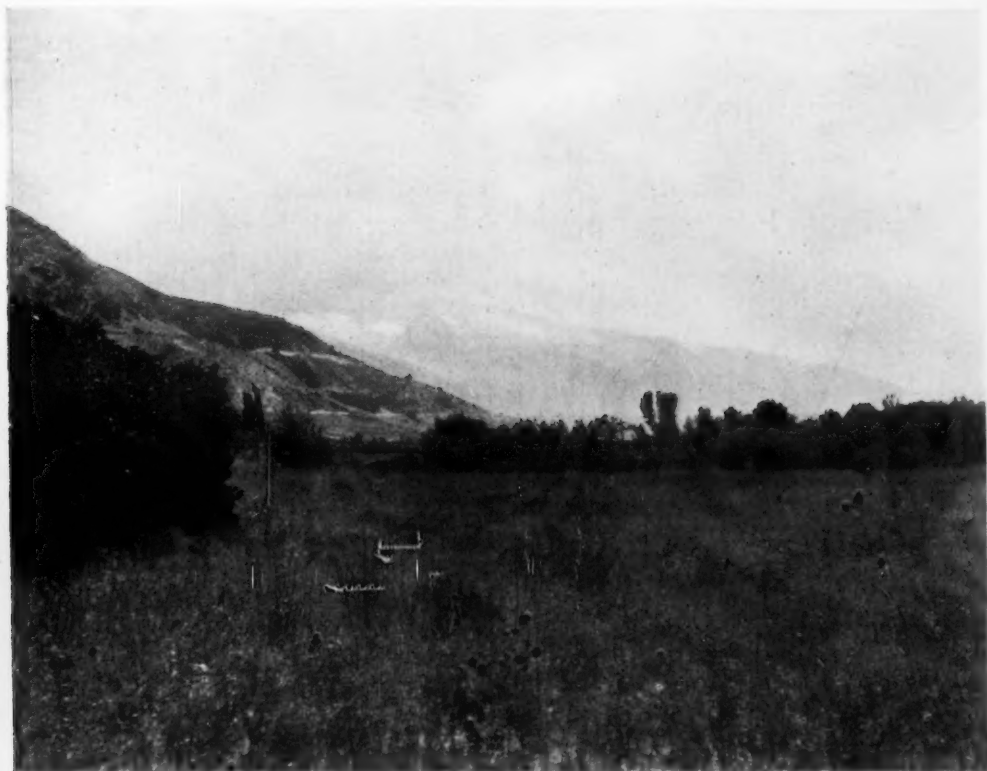


FIGURE 8.—Shore lines of ancient Lake Bonneville. The upper one, known as the Bonneville Shore line, forms a striking feature along the whole extent of the Wasatch and is plainly visible from all parts of the valley. The lower well defined one is the Provo shore line. The lake overflowed 375 feet between these levels and has since evaporated 625 feet down to its present level. (Photo by C. C. Colby.)

waters cannot be used for irrigation, but serve as a source of salt.

Most of Utah's important agricultural land occurs between Fielding and Santaquin in the fertile strip at the foot of the Wasatch, where numerous streams emerge from the mountains and flow toward the lakes. Along the entire extent of the Oasis the wall of the Wasatch is seamed by a series of streams, the Bear, Weber, Provo, and others, whose waters are diverted for purposes of irrigation in the valley lowlands.

The mountains on either side of the

The elevated portion has been so much eroded that its surface is a labyrinth of rugged mountains separated one from another by valleys and canyons. The west face of the range, which at one time was nearly straight and possibly a single cliff, is still precipitous and forms a prominent fault-scarp.

On the west side of the valleys the basin ranges stand low on the horizon in contrast to the stately Wasatch on the east. The most prominent of these is the Oquirrh Range, whose highest summits rise 9,000 feet above sea level.

ESSENTIAL CLIMATIC SIMILARITY

The Salt Lake Oasis has an arid climate primarily because of its interior location. It also lies in the rain shadow of the Sierra Nevada Mountains. As is readily shown by the closed character of its drainage,

rupted slopes.⁵ The heaviest precipitation falls during the winter and spring periods. This condition favors the production of dry-land wheat on the bench-lands because most of the vegetative growth of cereals takes place before June. The summers are normally very dry; the

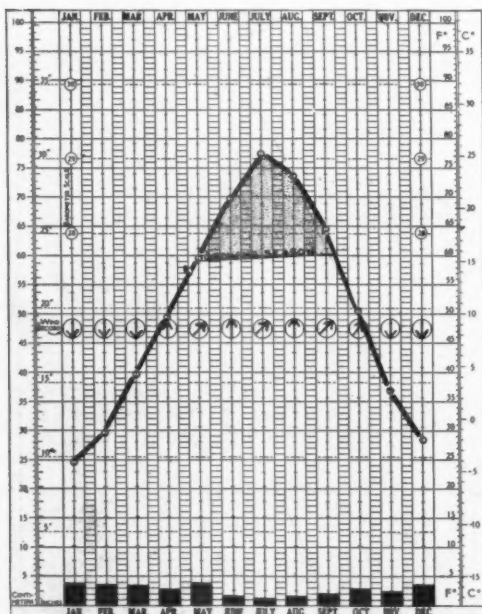


FIGURE 9.—Precipitation, temperature, wind direction, and length of growing season at Corinne on the plain, elevation 4,240 feet, just north of Bear River Bay. Corinne is typical of the plain while Ogden is typical of the bench lands. The difference is brought out in this and the following chart.

air as well as water can enter this region only by descent. Therefore, all winds reaching the Oasis tend to pick up rather than deposit moisture.

The average annual precipitation varies from twelve to twenty inches depending almost entirely upon topography. Precipitation begins to increase with altitude at a considerable distance west of the Wasatch and progresses at a fairly constant rate until near the summits where it begins to decrease. Though the local topography induces a variable altitude relation, the increase of about four inches annually per 1,000 feet is strikingly uniform over the gradual uninter-

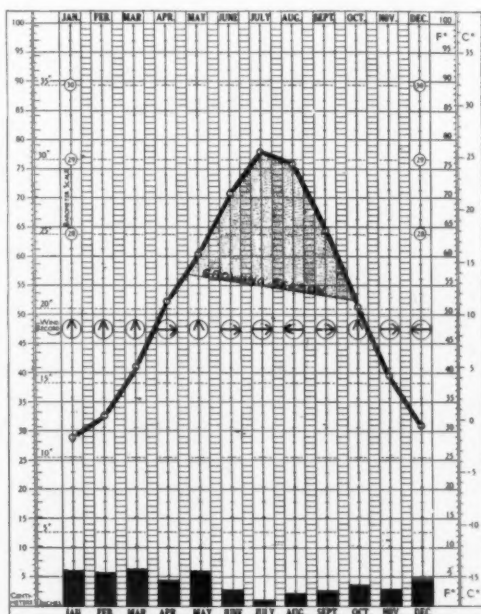


FIGURE 10.—Precipitation, temperature, wind direction, and length of growing season at Ogden on the bench, elevation 4,310 feet. A comparison of Figures 9 and 10 indicates the strong influence exerted by the bench-lands and the nearby mountains upon the length of the growing season and upon the amount of rainfall. Ogden has a mean annual precipitation of 18.92 inches, whereas Corinne has but 12.56. The average date of the last killing frost in the spring at Ogden is May 1 and at Corinne May 18; the average date of the first killing frost in autumn at Ogden is October 7 and at Corinne September 30. These conditions are admirably reflected in the agriculture of the two regions.

little rain which falls comes in light thundershowers and has little value. But this condition favors the raising of wheat, which requires dry weather during its final period of maturity and during harvest season. For the successful cultivation of most other crops, however, the farmers find it necessary to resort to irri-

⁵ Alter, J. C., "Normal Precipitation in Utah," *Monthly Weather Review*, September, 1919, 47, p. 633.

gation. The average number of stormy days, having 0.01 inches or more of precipitation, is about four a month in summer, eight in winter, and ten in spring, though the number increases with elevation.

Much of the precipitation comes in the form of snow. The annual snowfall ranges from about three feet at the lower levels to about twelve feet at the higher points of observation. Approximately 54 inches are received in the Oasis each year, 82 per cent of which falls during the four months December to March inclusive. The maximum amount, about 14.6 inches, is received in January.

The Oasis has the invigorating temperatures so characteristic of Western United States. The spring and fall months with average temperatures of 50° and 51°F. respectively, are exhilarating. High temperatures occur during the summer afternoons, though the difference between the actual and sensible temperature is so wide that the days are not oppressive. The nights are always cool. The winters are generally cold and dry, the average temperature for the period December to February inclusive being 30°F. The annual mean temperature for the Oasis is 51°F., the highest recorded is 110°F., and the lowest is -23°F., giving an extreme range of 133°F.

The great number of warm, clear, equable sunny days hastens the growth and maturity of crops. The average date of the first killing frost in the fall is September 30 at Corinne (Fig. 9) on the plain, and October 7 at Ogden (Fig. 10) on the bench. The average frostless season for the Salt Lake Oasis is 142 days.⁶

The evaporation from a free water surface during the summer at Provo is 35 or 40 inches. That from snow and ice surfaces and from water surfaces in winter and on early spring and late autumn days after freezing has been general, brings the average for the year to about 50 inches.

⁶ *Summary of the Climatological Data for the United States*, Reprint on Section 11, Western Utah, pp. 1-26, 1921.



FIGURE 11.—Well drained land in the Salt Lake Oasis is frequently sown with alfalfa. Since it feeds deeply, the water table must be at least 4 feet below the surface. When the soils become waterlogged on account of seepage or excessive irrigation, the crop loses its dark color, takes on a sickly yellow appearance, becomes interspersed with weeds, and yields a poor harvest.

UNIFORMITY OF SOILS

The soils of the Oasis are exceptionally deep and productive, having been laid down in ancient Lake Bonneville. During the lake period the washings from the upper valleys and mountains contributed largely to the filling of the lake, and in numerous places deposited detritus hundreds of feet thick.

Benches or deltas, consisting largely of

gravel, lie near the canyon mouths where lower gradient caused immediate deposition. The deltas are well drained; warm up early in the spring, and therefore afford excellent land for orchards, when water for irrigation is available. They are found only on the east side of the valleys because no large streams entered the old lake from the west. The sides of the valleys were mantled with sandy and loamy materials by the receding water,

while clay was deposited on the valley bottoms. The well drained middle belt on the valley slopes affords by far the best farming land (Fig. 11), because it is free from alkali and contains only small amounts of gravel. In contrast, the valley bottoms, where seepage water collects in the poorly drained, heavy clay soils, are likely to be alkaline or to become so (Fig. 12), especially if the higher lands are over-irrigated, as they often are in the Oasis. They can then be utilized only for grazing.

All the Oasis soils are high in phosphorus and potash, but lack humus and nitrogen. The rock materials furnishing the basis of these soils are largely of limestone origin, weathered from the adjacent mountains.

NATURAL VEGETATION REFLECTS PHYSICAL UNITY

The natural vegetation of the benches and the lacustrine plain reflects the aridity of the region and the character of the relief and the soil. The well drained bench-lands within the Oasis are occupied chiefly by the sagebrush association (Fig. 13); the dry saline land near the center of Salt Lake Valley is carpeted with shadscale and to a limited extent with white sage; the land in the lower part of the valley where the surface is dry but where the subsoil is moist, bears a mixed stand of greasewood and shadscale (Fig. 14); the lowest places near the lake shore, which have a strongly saline surface and a wet subsoil, bear the salt-flat type of plants; and the moist moderately saline areas that lie between the two preceding are occupied by grass-flats. Thus the natural vegetation of the region consists of several easily recognized plant communities, of which the distribution is determined largely by moisture relations and the salt content of the soil.

These types of vegetation are, therefore, reliable indicators of the soil and climatic conditions within the region, and assist the farmer, especially the dry-farmer, in determining the suitability of the land for agriculture. The sagebrush



FIGURE 12.—A portion of the valley bottom west of the heavily irrigated "Sand Ridge" near Hooper. This land, once profitably farmed, lies idle now because of water-logging and small accumulations of alkali at the surface. It can be reclaimed by underdrainage, but this is not feasible under existing economic conditions.



FIGURE 13.—Sagebrush originally covered most of the bench-lands, which are characterized by heavier rainfall than the plain, and by soils of rather coarse texture that often contain gravel. Sages grow best on alluvial fans near the mouths of canyons where moisture received directly as precipitation is supplemented by water from the mountains.



FIGURE 14.—Typical alkaline vegetation in the area west of Salt Lake City between the River Jordan and Great Salt Lake. This vast virgin section of level but unoccupied land, lying at the very door of the best market in the intermontane country, will not be embodied in the agricultural area of the Oasis, until it is underdrained.

association indicates a soil suitable for crops and also an amount of rainfall that may permit the production of wheat or barley by dry-farming methods; practically all the Oasis bench-lands now

devoted to grain and orchards were originally occupied by the sagebrush association. On the other hand, white sage, shadscale, and greasewood, indicate alkaline conditions and are therefore

avoided by the dry-farmers. Shadscale land affords pasture to livestock and so furnishes a valuable resource. The low, grass-flat land is too wet and saline to be of agricultural value unless it is drained.

THE INDUSTRIAL INTEGRITY

The Salt Lake Oasis shows industrial as well as physical unity. With a strategic commercial location in the intermontane region, with a hinterland rich in natural resources, and with a population density of 390.7 persons to the square mile, it is but natural that the Oasis is the agricultural, the manufacturing, and the commercial center of the intermontane country. To the native and the transient alike, this strip of human habitation and industry at the foot of the Wasatch is "Utah."

THE SELF-SUFFICIENCY OF AGRICULTURE

Dwarf holdings, cultivated thoroughly, characterize the Salt Lake Oasis. They are consequent upon scarcity of arable



FIGURE 15.—The holding of a typical "town dwelling farmer" at Centerville, north of Salt Lake City. With but five to twenty acres of irrigable land, these farmers must cultivate their land intensively in order to make a labor income adequate to care for their large families. (Photo by C. C. Colby.)

land, a limited amount of water for irrigation, and dense population. When Brigham Young framed his cooperative system of irrigation, he taught his followers that farming in this region could succeed only with a small farm unit intensively

tilled (Fig. 15). He realized that value resided in water rather than in land, and therefore allotted to each family only as much ground as it could faithfully cultivate. His system was admirably suited to the natural environment of the Oasis and to the needs of a young and small settlement; but serious limitations were revealed when population increased and large scale agricultural enterprises became imperative.

Labor income derived from the 5-, 10-, 15-, and 20-acre farms, even when intensively tilled, is insufficient to meet the needs of the large Mormon families.⁷ To ameliorate their condition and extend their agricultural operations, the farmers are now renting or purchasing additional land, raising grain on the bench-lands under dry-farming methods, or running cattle and sheep on the mountain and desert ranges. Dry-farming, because of the limited extent of suitable land, is limited; and similarly range-grazing on the heavily-stocked national forests because of the restricted grazing permits, is restricted.

In addition to the handicap of dwarf holdings, the Oasis farmers labor under obvious disadvantages incident to their concentration in towns and villages, a heritage of Indian days, when communal settlements were necessary for protection and a man's land lay outside the fort in more or less intermingled strips, after a fashion of certain European countries, especially France (Fig. 16). Each day during the busy season the farmers lose several hours en route from town to farm. They are prohibited from many small economies and secondary farm activities which would greatly increase their revenue. They find it impracticable to keep livestock and poultry, except for a few chickens and a cow in town, both serious nuisances to the neighbors. When cows are kept, they are put on rented pastures

⁷The "labor income" is the amount that the farmer has left for his labor after 5 per cent interest on the average capital is deducted from the farm income. It represents what the farmer earned as a result of his year's labor after the earning power of his capital has been deducted.



FIGURE 16.—In the Oasis probably 90 per cent of the farmers live in towns and villages. This is a heritage of Indian days when the settlers lived within a fortification for protection and their farm land lay outside its walls. (Photo by C. C. Colby.)

during the day and led home at night by small boy herders. These town-dwelling farmers also find it next to impossible to keep swine and sheep. The result is that they lose not only the produce from livestock, but the manure which is so indispensable to efficient tillage.

CHARACTERISTIC DIVERSITY OF CROPS

The Mormon farmers long ago learned that it was not wise to depend upon any one crop as do the wheat farmers of the Great Plains, the cotton-croppers of the South, the potato-growers of the north-central states, and the citrus-fruit producers of California and Florida. They accordingly diversify their crops to such an extent that the farms resemble gardens (Fig. 17). Notwithstanding this marked diversity, approximately three-fourths of the cropped land is devoted to

sugar beets, alfalfa, and wheat, fields of which alternate almost as regularly as the squares of a checkerboard, so carefully planned is the rotation system; the remainder is in fruits and vegetables (Fig. 18). The variety of crops in this well irrigated region, however, is not limited by the possibility of production, but rather by the probability of consumption. With limited local markets, small farms, and costly land, crops having high value per unit of weight must be grown, for only they can stand transportation costs to distant markets.

The sugar beet, the cash crop of Utah, is confined largely to the Oasis, where natural conditions are almost ideal for its production (Fig. 19). This limitation of distribution is not entirely a question of adaptation but of proximity to a factory to make the business profitable. The sugar beet is grown by about 75 per cent



FIGURE 17.—Diversified farming in the Centerville district near Salt Lake, where land values are highest and cultivation most intense. This is a portion of the market garden section.



FIGURE 18.—A young peach orchard on the Provo Bench. Most of the fruit is grown under irrigation on bench-lands, which are favored with air drainage and shadow protection and which warm up quickly in the spring. Alfalfa is frequently planted between the trees to prevent soil erosion and to serve as green manure.

of the farmers, and in 1919 occupied 16 per cent of the cropped land. It is ideally suited to the small intensively tilled Mormon holdings. Usually the most fertile and best drained piece of irrigated land is devoted to this crop. The average plot in beets is about 8 acres; this

is as much as the average family can care for, because beet culture requires from six to eight times as much labor per acre as wheat or alfalfa (Fig. 20).

Alfalfa, the mainstay of Oasis agriculture, occupies more than one-fourth of the cropped land. Wherever land is irri-



FIGURE 19.—Where arable land is limited, water scarce, families large, and markets remote,—land and water are costly, farms are small, and crops yielding a product, high in value per unit of bulk, must be produced. In the Oasis, where these conditions prevail, the sugar beet serves as the most reliable cash crop and is grown exclusively by scores of farmers.



FIGURE 20.—Beet plots average approximately eight acres per farm. Beets are generally planted on the most fertile and best piece of irrigable land on the farm. The average yield is about 12 tons per acre, though many farmers get as many as 20 tons.

gated and well drained, some alfalfa is grown. In Utah it is consumed locally, and its distribution coincides closely with that of farms. Alfalfa is raised by nearly all farmers because it is not an intertilled crop and therefore requires a small amount of labor; because it provides hay

and excellent fall pasturage; because as winter feed it is excellent for cattle and sheep which spend the summers grazing in the national forests; because it supplies fertilizer in the form of nitrogen and humus; and because it improves the tilth of the subsoil. Unlike wheat, it competes

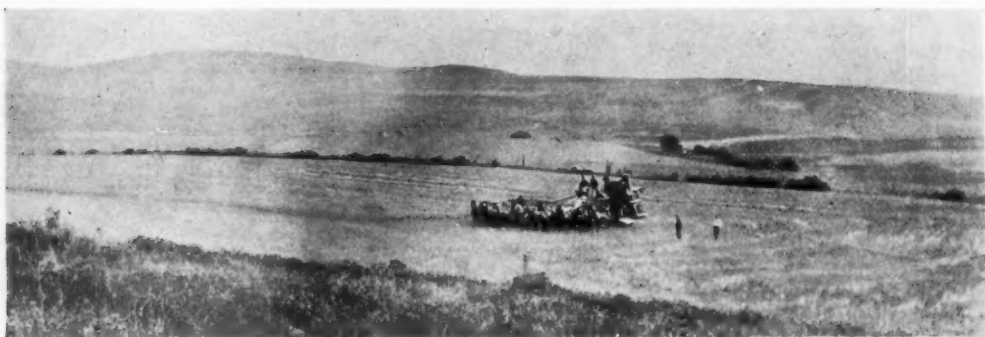


FIGURE 21.—The only profitable crop adapted to environmental conditions on the unirrigated bench-lands of the Oasis is winter-wheat, which is grown under dry-farming methods. In this region, dry-land wheat is harvested mostly with combines, because there is seldom danger from hail, rain, or wind, and the grain is thoroughly ripe. (Photo by A. F. Bracken.)

successfully with intertilled crops for the better lands of the Oasis.

Wheat is grown under irrigation on the lacustrine plain and by dry-farming on the bench-lands (Fig. 21); approximately 60 per cent of the acreage in the five Oasis counties is dry-farmed. There is a tendency to push wheat from the small expensive irrigated holdings to the larger and cheaper dry-farmed lands, because wheat is the least profitable of the crops grown under irrigation and is the best adapted to dry-farming conditions; but

wheat is not likely to be eliminated entirely from the small irrigated farms (Fig. 22), because it fits into the rotation generally practiced, is a cash crop, supplies feed for poultry, and equalizes the seasonal requirements for labor. Most of this wheat is milled locally.

Although the Oasis produces but a small proportion of Utah's wheat, it does raise about four-fifths of its fruit. The geographic distribution of this crop, while determined largely by physical factors, is restricted by economic factors. The



FIGURE 22.—In those parts of the Oasis but recently brought under the ditch, the farms are much larger than those in the sections first settled. Consequently, farming is more extensive and wheat is one of the chief crops.

bulk of the fruit is produced near cities on the irrigated benches, which are protected from premature frosts, by air-drainage and shadow protection. When orchards occur on the plain, they lie adjacent to water bodies which diminish the risk of killing frosts.

39.3 per cent of the land in farms was in pasture as against 29.4 per cent in crops. Large farms, which include extensive acreage in pasture, develop the dairy industry (Fig. 24). These adjoin Utah and Great Salt Lakes, where much of the land is water-logged. The grazing lands



FIGURE 23.—Since a surplus of tomatoes is produced in the Oasis, canning has become an important industry. By means of excellent transportation facilities, both steam and electric, and by the best system of highways in the state, the growers are brought into close contact with the canneries. The combination of production, transportation, and preservation has greatly added to the prosperity of the region.

Like fruit, vegetables in Utah are confined largely to the Oasis, which produces about two-thirds of the crop based on acreage (Fig. 23). Nearly all the vegetables grown for sale are raised near Salt Lake City, Ogden, and Provo, where they find a good market.

IMPORTANCE OF PASTURES

Oasis pastures usually occupy the sections that are too dry, too wet, too alkaline, or too rough for the cultivation of crops. In 1910, 136 acres on farms were devoted to pasture for every 100 acres planted with crops.⁸ In other words

⁸ Goldenweiser, E. A., and Ball, J. S., "Pasture Land on Farms in the United States," United States Department of Agriculture, Bulletin No. 626, p. 84, 1918.

for most of the animals in the Oasis, other than the milch cows, lie in the desert to the west and the national forests to the east.

SIGNIFICANCE OF NEIGHBORING MOUNTAIN FORESTS

Forests are confined largely to the Wasatch Mountains, where a comparatively heavy rainfall produces proper conditions for forest growth. These tree-clad lands are controlled by the Federal Government and are used for timber, grazing, and recreation (Fig. 25). Because the forests delay the melting snows in the mountains and prevent spring floods, they are of inestimable value to the Oasis farmers; and in the summer



FIGURE 24.—One of Utah's best herds of Jerseys on a typical water-logged pasture near Provo. The succulent grasses of these pastures furnish excellent summer feed.



FIGURE 25.—An Engelmann spruce forest of excellent development on the headwaters of the Provo River. (Photo by U. S. Forest Service.)

pasturage which they afford, the cattle and sheep of the Oasis find ample food for the warm season (Fig. 26).

LIVESTOCK OF THE OASIS AND THE TRIBUTARY RANGE

The well-tilled Oasis bears an intimate relation to the livestock industry of its hinterland. Its location between the grazing lands among the forests of the lofty Wasatch Mountains on the east and the lower basin ranges and the desert on the west, makes the Oasis the magnet to which many of the animals, especially cattle, are drawn for winter feeding (Fig. 27), when the mountains cannot be grazed, and the deserts can be utilized only by sheep and goats. Furthermore, the alfalfa and sugar beet and grain by-products, can be marketed profitably only in the form of livestock.

The large areas in pasture, the abundance of farm by-products, and the dense population of the Oasis, which insures an excellent local market, favor the keeping of dairy cattle. Accordingly, it is in this region that most of the milch cows in Utah are to be found.



FIGURE 26.—In the mountains adjoining the Oasis, where there is adequate moisture for the growth of forests, many open spaces covered with grasses and herbaceous plants furnish good summer forage for about 108,000 cattle and horses and 462,500 sheep. (Photo by U. S. Forest Service.)



FIGURE 27.—Winter-fed lambs in a Mormon farm village. Winter feeding of cattle and sheep that graze in the National Forests in summer, is becoming a profitable and important activity, since Utah's large alfalfa crop is locked within its borders by a quarantine against the alfalfa weevil, and since its sugar beet and grain by-products can be marketed only through livestock. (Photo by U. S. Forest Service.)

Swine are relatively unimportant in the Oasis, there being but 3.8 animals per farm in the five Oasis counties in 1919. It is not easy to account for the small number of swine, since excellent feed in

the form of corn, alfalfa, wheat, barley, oats, sugar beets, potatoes, and fruit is produced, and there is a good local market for pork and pork products. The farmers maintain that there is no money

in swine. Probably the chief reason why so few are reared is that the majority of the farmers live in towns and villages, where pig pens would be a serious nuisance.

Poultry production is a prominent activity in the region, there being more than 1,000,000 fowls in the five Oasis counties in 1923.⁹ Climate, soil, feed, and selling organization are the factors that influence the industry. Of these climate is probably most important because of its effect upon the cost of production and upon the health of the fowls. The dry, pure air and the bright sunny days retard disease and stimulate egg production. The wide variety of well-drained soils makes it possible to produce practically all kinds of poultry feed. The first class eggs are sold in New York and Los Angeles by a coöperative organization. The rest are distributed locally among bakers and other buyers of second grades.

THE CONCENTRATION OF MANUFACTURES

On the basis of value approximately 80 per cent of the manufacturing of Utah in 1919 was carried on in the Salt Lake Oasis. The geographic factors responsible for this concentration of factory industry are: (1) high agricultural and mineral productivity, (2) relatively cheap power, both coal and hydro-electric, (3) isolation from the large industrial sections of the country, making it necessary because of high freight rates to convert surplus bulky food stuffs into concentrated forms for transportation to distant markets, and to work up certain materials into finished articles for home consumption, (4) dense population, about 61 per cent of that of the state, (5) excellent transportation facilities, (6) skilled labor, and (7) strategic location in the intermontane region, by which it becomes the natural collecting and distributing center.

⁹ Alder, Byron, Utah Agricultural College, Logan, Utah. Personal Communication.

DEVELOPMENT OF MANUFACTURING

Since the Mormon pioneers were 1,000 miles from the nearest source of supplies, they were driven by necessity to convert the native raw materials into usable form. They were urged by their leaders to become independent of the outside world as far as possible, and to supply their needs in home manufactories. Thus Brigham Young's message to the legislature in 1852, five years after settlement, is significant: "Deplorable, indeed, must be the situation of that people whose sons are not trained in the practice of every avocation and whose daughters mingle not in the hive of the industry; produce what you consume; draw from the native elements the necessities of life; permit no vitiated taste to lead you into indulgence of expensive luxuries which can only be obtained by involving yourselves in debt; let home industries produce every article of home consumption." This advice was heeded; small plants sprang up at those places which were favored by water power, raw material, and market for the manufactured articles.

FLOUR MILLING

The history of flour milling in the Oasis has been one of uninterrupted progress and development. With the harvesting of the first crop at Salt Lake City, the immediate necessity arose for converting the grain into flour. Mountain streams were harnessed for power, and mills were built wherever colonies were established. These simple plants, sufficient in number to supply the needs of the people, were the modest beginning of the present large scale development of milling.

The Oasis contains 34 of Utah's 77 flour mills and all the large ones; Ogden claims 9 of these and Salt Lake 7; the remainder are scattered generally throughout the region, though usually near the producing bench-lands and near transportation lines. Ogden is the milling center of the intermontane region (Fig. 28), because of its strategic location with reference to



FIGURE 28.—The Sperry Flour Mill at Ogden, one of the largest and up-to-date in the West, located here because the city commands milling wheat from all adjoining states and can ship its manufactured products in all directions when competition permits. The grain exchange is located here and all grain shipped in the intermontane region must pass through it. (Photo by Sperry Milling Company.)

wheat producing areas, railways, and markets. This city, the hub of intermontane transportation, is the collecting and distributing center for northern Utah, the granary of the state, and for the important producing sections of southern Idaho. Monthly inspections of wheat in Ogden from July, 1924 to April, 1925, averaged 378 cars, of which 300 were receipts and 78 shipments. Ogden has several large modern plants with a combined storage capacity of 2,500,000 bushels in which high grade flour for home consumption and for export is milled.

SUGAR REFINING

The Oasis is a pioneer in the beet sugar industry of the United States. In 1852 sugar machinery was purchased in Liverpool, shipped by way of New Orleans and the Mississippi and Missouri Rivers to Independence, and thence freighted overland to Salt Lake City. This plant was not successful. In 1891 another estab-

lishment, the third to be operated successfully in the United States, was erected at Lehi. It has been enlarged three times and now has a capacity of 1,400 tons of beets per day and makes about 30,000,000 pounds of sugar annually.

Twelve of Utah's nineteen factories are located in the Salt Lake Oasis, where most of the beets are grown (Fig. 29). Fertile well-drained soils, favorable weather, adequate water for irrigation, broad comparatively level stretches of land, good roads, excellent railway facilities, small farms, and dense population, all combine to make conditions ideal for the growing of the beets. While factories should be located within fifty miles of the producing region, those in the Oasis are strung along the base of the Wasatch at average intervals of about eleven miles, with the result that there are large numbers of mills in a restricted area (Fig. 30). This concentration reduces the profits of the individual factories, but in 1923 they handled about 678,280 tons of beets from



FIGURE 29.—This plant of the Amalgamated Sugar Company at Ogden lies in the heart of one of Utah's most important beet districts. First built in 1898, the plant has been enlarged until it is now a model cutting 900 to 1,000 tons of beets per day and employing hundreds of men. (Photo by Amalgamated Sugar Company.)

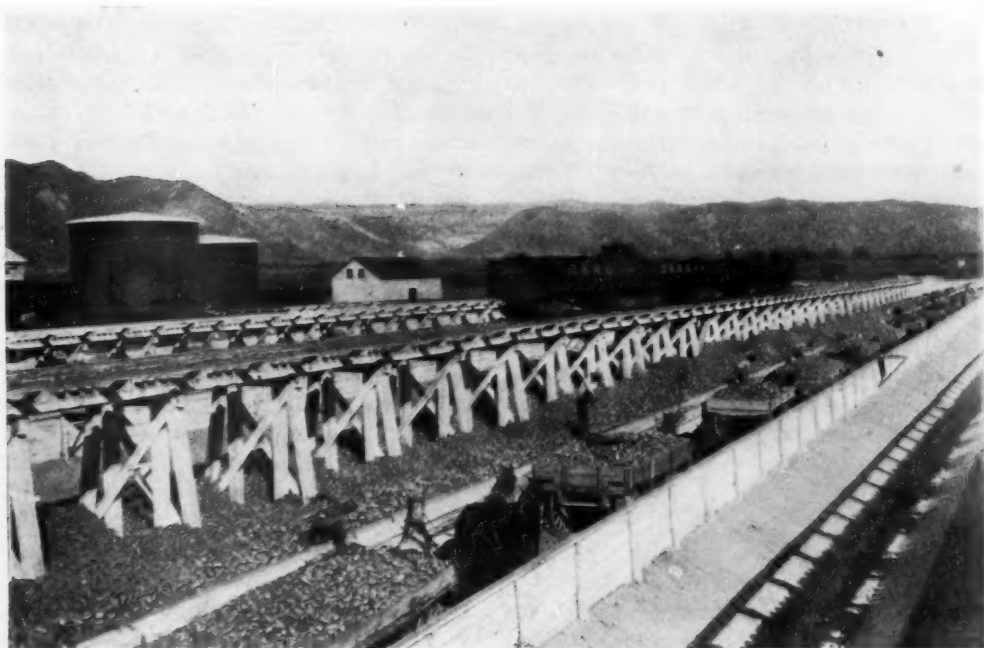


FIGURE 30.—Unloading sugar beets at a factory of the Utah-Idaho Sugar Company. Since most of the beet land lies only five or six miles from a steam or electric railway, the sugar companies have dotted the region with loading stations which reduce to a minimum the farmers' expense of hauling their product to market. Only about 10 per cent of the beets are delivered directly to the factories by the growers. (Photo by Utah-Idaho Sugar Company.)

which they made 183,244,200 pounds of sugar valued at \$13,285,204.00.

FRUIT AND VEGETABLE CANNING

Dotting the agricultural landscape of the Oasis from Tremonton on the north to Spanish Fork on the south, are 35 of Utah's 38 canning factories.

From about September 4 to October 15, the black smoke that pours from the chimneys of these conspicuous rural workshops emphasizes the importance of this industry. The success of most of the truck farms is largely dependent on canning. Prior to the beginning of this industry in 1888, the farms that now produce vegetables and fruits raised only wheat, alfalfa, and potatoes.

The geographic factors that determine the location of the canneries are: (1) proximity to vegetables and fruits, which in turn demand favorable climate, relief, soil, and drainage, and (2) good roads and excellent railway facilities.

Fifteen of the thirty-five factories operate in the Ogden district, on a large delta of the old lake about twenty miles in diameter, which has a soil and climate ideally adapted to the growth of an especially desirable type of tomato with deep red color. Since these vegetables must be packed within five or six miles of a factory to avoid deterioration, this district, the tomato section of the state, is dotted with canneries. In 1923 it packed approximately one-half of the to-

tal pack of 2,500,000 cases of fruits and vegetables.

MEAT PACKING

The Utah meat packing business, concentrated at Salt Lake City and Ogden, though of small proportions, is probably destined to become one of the leading industries of the state. No section of the intermontane region is so well located to carry on this pursuit as the Oasis, because it is surrounded by land suitable only for grazing. Millions of sheep and cattle are likely soon to be slaughtered annually in these cities of the Oasis, with their focal position in the region. Furthermore, the Oasis produces a surplus of alfalfa and grain which can be marketed most profitably through livestock, because of its higher value per unit of weight. Here too, are the best transportation facilities in the intermontane region, which give access to admirable markets. The Pacific Coast cities, especially Los Angeles and San Francisco, will take all of Utah's surplus meat; hence it is to this market that the Mormon stockmen are looking. Utah, a great range state, lies nearer the Pacific Coast than do its competitors, Kansas, Nebraska, Colorado, Wyoming, and Idaho; it has, therefore, a decided advantage in the shorter haul.

THE PREPARATION OF SALT

The needy pioneer Mormons were quick to utilize for salt the waters of

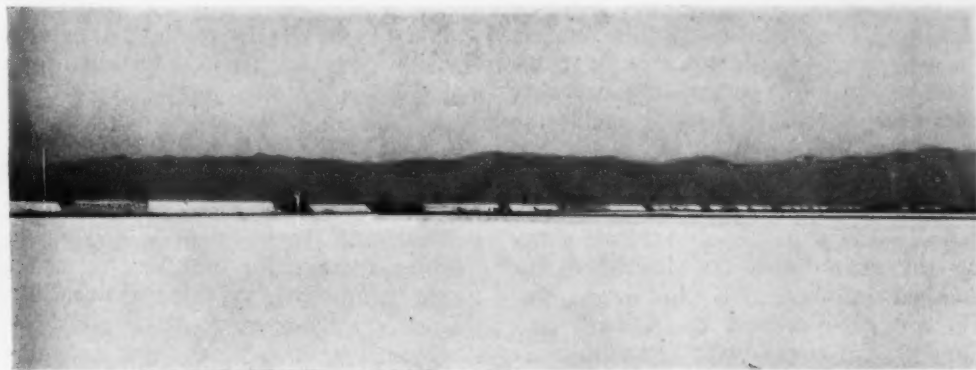


FIGURE 31.—Salt flats near Great Salt Lake west of Salt Lake City. Salt water is pumped from the lake onto flats where it evaporates, leaving common salt. (Photo by Inland Crystal Salt Company.)



FIGURE 32.—Utah Copper Hill after the removal of more than 150,000,000 tons of ore. Twenty-four terraces gird the mountain,—each double-tracked and equipped with work trains and steam shovels. The engines and cars on the upper levels look like toy trains. After blasting, the crumbled ore is scooped into cars and delivered to the concentrating mills, and thence to the smelter at Garfield. The Utah Copper Company treats 40,000 tons of ore per day. (Photo by Deseret Evening News.)

Great Salt Lake. Discovering that the lake rose and fell with the seasons, they diked off a narrow strip each spring when the waters were high, allowing the latter to evaporate during the hot summer months. They continued this method for many years, but it was unsatisfactory because gypsum, potash, and glauber salts were mixed with the sodium chloride (common salt).

In 1889, however, it was discovered that the various substances were deposited when the water reached certain varying saturation points. This discovery changed the whole method of extraction. The water is now pumped from the lake onto diked flats (Fig. 31) and with a series of three ponds the density is so maintained that almost pure salt is pre-

cipitated in one pond, and the other substances in the other two.

After evaporation, the salt is dug and removed to a refinery, where it is dried, refined, ground, screened, and packed. It is then nearly 100 per cent pure and is distributed throughout the intermontane region.

THE SMELTING OF ORES

The smelting of ores surpasses all other Oasis manufactures, the value amounting in 1924 to more than \$65,000,300. The ores from the nearby mountain mining camps (Fig. 32) flow as naturally toward the Oasis as do the clear sparkling streams. Since most of the Utah minerals are of low grade (the crude copper contains only 1.5 per cent pure metal),



FIGURE 33.—Plant of the American Smelting and Refining Company at Garfield and the homes of the workers. The barren nature of the surroundings is resultant from the poisonous fumes of the smelter. (Photo by American Smelting and Refining Company.)

they cannot stand transportation costs to eastern smelters and refineries, but must be treated locally.

The Oasis affords an excellent location for these plants with respect to both the ores and power. It has excellent transportation facilities, and its dense population insures adequate labor.

When smelters are centrally located, they draw on a larger hinterland than when located at mines, and consequently are more efficient. The three great plants, operating at Garfield (Figs. 33 and 34), Murray, and Midvale, handle daily more than 3,000 tons of lead and silver ores, and more than 2,000 tons of crude copper ores. About 70 per cent of the lead-silver ore comes from the nearby camps at Tintic, Park City, Bingham, Alta, and Big Cottonwood; the remain-

der comes from Nevada, California, Idaho, Arizona, Montana, Colorado, and even from British Columbia. The copper, which is smelted at Garfield, comes almost wholly from the great copper mountain in Bingham Canyon.

These are the more important manufacturing industries not only in the Oasis but in Utah as well. All emphasize the same principle,—that products from this surplus region, far removed from the great centers of population and consumption, must be exported in a concentrated form in order to stand costs to distant markets.

THE RESULTANT COMMERCE

The development of trade in Utah from 1847, when probably the entire cash capital of the Mormons did not exceed



FIGURE 34.—Remainder of smelting plant at Garfield. This smelter is notable among those of the world for the huge tonnage of copper concentrates which it handles. During 1924 it smelted 856,000 tons of copper ore and concentrates and produced 125,000 tons of copper bullion. (Photo by American Smelting and Refining Company.)

\$3,000, till now, when the large commerce of the intermontane country is centered in the Oasis, presents some interesting and anomalous features. At first the Mormons desired to avoid all traffic with the outside world; but as emigrants passed through their settlements, they exchanged goods with them to mutual advantage. At home they traded by barter and the due-bill system. Until 1869 the Mormons had little use for money and preferred taking in exchange for their farm produce something they could eat, drink, or wear, and which they could not produce at home. Accordingly, scores of wealthy farmers seldom possessed a dollar in coin.

This trade relationship was revolutionized by the advent of the Union

Pacific in 1869, 22 years after the first settlement in Salt Lake Valley. This road made it evident that Salt Lake City and Ogden would become important commercial centers (Fig. 35). Soon a struggle for commercial control between the Mormons and Gentiles began and is still in progress. The Union Pacific thus brought to Zion a new and manifest destiny. It opened up to the people a wide market which by 1869 they desired vastly more than they had ever desired their secluded place of refuge. It introduced an interchange of goods with the East and the West.

Local railway lines, controlled by Mormon capital and built by Mormon labor, sprang up immediately. The Utah Central, operating between Ogden and Salt

Lake City, was completed by January 1870. The Utah Southern, running from Salt Lake City to Juab, 105 miles to the

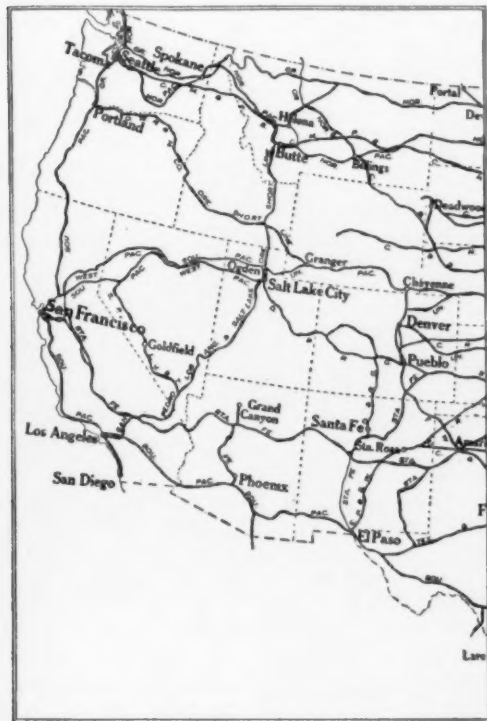


FIGURE 35.—Trunk railway lines radiate from the Oasis like the spokes of a wheel, thereby emphasizing the strategic commercial locations of Ogden and Salt Lake City. The courses of these lines have been determined largely by physical factors. (From J. R. Smith's *Commercial and Industrial Geography*.)

south, was opened for traffic in 1879. The Utah Northern extending from Ogden to Franklin, Idaho, via Bear and Cache Valleys, had reached Logan by January, 1873. The Utah and Nevada, reaching west from Salt Lake City along the shore of Great Salt Lake, thence around the Oquirrh and south across Tooele Valley, was begun in 1873. Branch lines of the Utah Central and the Utah Southern soon penetrated the mining camps of Bingham, Little Cottonwood, and American Fork Canyons, and for the first time in Utah history mining became important.

In 1883 the Denver and Rio Grande Western entered the Oasis southeast of

Springville en route to Ogden. This road conferred immediate benefit upon the Mormon settlements in Utah and Salt Lake Valleys by reducing freight rates through competition and stimulating the development of nearby mineral resources.

The coming of the Los Angeles and Salt Lake in 1925 is regarded by Smythe as the most important single event in Utah history after the building of the Union Pacific, because it opened up a large mineral, agricultural, and stock region south of Salt Lake City, and fostered the interchange of products between two contrasted agricultural regions,—southern California and central Utah. It is an interesting and significant fact that the course of this typical piedmont road in a desert region was determined by the string of Mormon towns at the base of the Wasatch and San Pitch Mountains which in turn were dependent on the streams that emerged from the mountains.

The Oregon Short Line, a part of the Union Pacific System, utilizes the route of the old Utah Northern. The Western Pacific, connecting San Francisco and Salt Lake, first reaches the Oasis at Garfield and proceeds eastward for fifteen miles to Salt Lake City. Three electric suburban roads, serving approximately 60 per cent of the people of Utah, operate in the Oasis.

The Oasis must dispose of its surplus agricultural products outside the sparsely settled intermontane region. Therefore, it must produce commodities that have either high value per unit of weight or that can be converted into concentrated form for transportation to distant markets. This condition accounts for the character of the manufactured products.

The region, nevertheless, encounters difficulty in competing in eastern markets, because it has to pay the highest freight rate per mile of any section in the United States. For this reason the Utah farmer cannot market his agricultural products in the East as advantageously as the Pacific Coast rancher, despite the fact that he is 600 miles closer to his mart. This situation is attributable to



FIGURE 36.—As the ultimate development of the civilization of a people is expressed in the temples consecrated to their spiritual idealism, so the crowning glory of the culture of the Salt Lake Oasis is the Temple of the Mormon Church about which the vibrant life of the Oasis is centered. This temple is one of the architectural masterpieces of the world.

low transcontinental and high intermediate rates imposed by railroads in their effort to compete with steamships. Consequently the Mormon farmers are able to sell their fruits and vegetables at a profit only when the yield is below normal in the East; at all other times they either break even or lose. Obviously the Oasis has not yet found the ideal system of farming in relation to adverse discrimination in freight charges.

The exports include 89 per cent of the refined sugar to Wyoming, Montana, Nevada, and the lower Missouri and upper Mississippi Valleys, 80 per cent of the flour to California and the Cotton Belt, depending on the crop and price conditions, 60 per cent of the canned fruits and vegetables to all parts of the country, the first class eggs to New York City and Los Angeles, fresh slaughtered meat to Los Angeles and San Francisco, livestock on the hoof to the great packing centers, fresh fruits and vegetables to Chicago, smelted silver-lead ore to East

Chicago and copper bullion to Baltimore, and salt to the intermontane towns and villages.

The chief imports comprise machinery, tools, implements, clothing, dry goods, furniture, and extraneous food products from the industrial East, hogs from Nebraska, Kansas, Colorado, and Idaho, sheep and wheat from the intermontane country, lumber from the Pacific northwest.

THE INTERDEPENDENCE OF THE INDUSTRIES.

No section of the United States is so distinctively and interdependently integrated as is this insular oasis. Without the intensive agriculture, manufacturing and commerce would languish, without manufacturing, agriculture could not prosper and commerce would consequently be negligible; without commerce the manufacturers would be curtailed and agriculture would be limited to local needs.

It is this interdependence of industry, quite as much as the determinative influence of the natural environment and the insularity of the Oasis, that characterizes the region. Its products and its industries, its needs and its surpluses, its exports and its imports, its limitations and its restraints, all these reflect this interdependence as clearly as they do the insularity of location and the influence of the physical conditions.

SUMMARY

The Salt Lake Oasis in wealth, population, and stage of economic and cultural development is the capital of the intermontane country. Originally one of the most barren spots in the western wilderness, this region has become one of the most fruitful in America. With the unkindly soil, the lack of trees, except such as grew here and there in narrow, rock-ribbed gorges, with fuel almost inaccessi-

ble at points where habitation was possible; and with no near neighbors,—amid this repellent and inhospitable region, the Mormons made their busy settlements. Within the three score and ten years allotted to a man's life they transformed this barren waste into a verdant island teeming with industry; they made of the arid unproductive soil a rich garden; they conquered the climate with its aridity and its extremes of heat and cold; they brought in lumber from the forests of the Wasatch; they found the fuel they needed for their factories; they made of their "Deseret" a caravansary for the world's travel; they set among the rock-ribbed hills, a gemlike City with all its beneficences and all its felicities; and they made their sanctuary the insular seat of civilization in the wilderness, sufficient unto itself but hospitable to the peoples of the far corners of the earth.



FIGURE 37.—The Sea Gull monument in Temple Square, Salt Lake City, commemorates the salvation of the early settlers from the swarms of devastating locusts by the flocks of sea gulls that swept in to devour the plague. This bit of art indicates better than the most inspired phrase the culture to which the people of the Salt Lake Oasis have attained.

THE GEOGRAPHIC EFFECTS OF THE PROPOSED GREAT LAKES-ST. LAWRENCE WATERWAY

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THE geographic effects of the deepening of the Great Lakes-St. Lawrence Ship Channels depend primarily upon economic considerations. The mere existence of an improved channel will manifestly produce no change in the economic conditions now prevailing in the Prairie States and adjacent Canada and can therefore have no influence upon the geographic conditions in this district.

ARGUMENTS FOR THE WATERWAY

The advocates of the proposal argue that the deepening of the present canals between the lakes to 25 feet, and the construction of dams and of new canals around the rapids of the upper St. Lawrence River, will result in greatly increased use of the St. Lawrence and Great Lakes waterway and that ocean vessels will follow this route.



FIGURE 1.—Plowing for wheat on the Albertan prairies. Even the farmers of the great Canadian Northwest would benefit by the opening of the Great Lakes-St. Lawrence Waterway in the lower cost of getting their grain to market; and their prosperity, like that of the grain growers in northwestern United States, means a surer, cheaper supply of bread for all the workers in the East. (Courtesy of the Canadian Pacific Railway.)

Its utilization, however, may have a profound influence not only in decreasing the cost of getting the farmers' grain to market (Fig. 1) but in furnishing cheap power through hydro-electric installations to manufacturers in Ontario and the States within 250 or 300 miles of the waterway.

At present about 4,000,000 tons of merchandise, 40 per cent of which is grain, are carried by vessels of 14 feet draft through the St. Lawrence. When the waterway is made deep enough for vessels of 25 feet draft, over 80 per cent of all ocean craft will be able to pass to and from lake ports and will be able to



FIGURE 2.—Harbor Channel and Victoria Bridge, Montreal. The Sault-Norman Rapids race turbulently along just below the bridge. (Photo by C. F. Jones.)

carry freight from these ports to Atlantic ports at a rate that will be less than the lake and rail rate; and direct to European ports at a rate which is even more favorable as compared with costs through New York or other Atlantic outlets. The necessity of transferring cargo at Montreal, as at present, will be avoided, because vessels of 25 feet draft may proceed to sea without much more danger than is encountered by the world's merchant fleet now traversing the seas, since 85 per

cent of the vessels of this fleet are of no greater draft than this.

The present lake commerce passing Detroit River aggregates more than 100,000,000 tons; the total tonnage of the shipping over the upper St. Lawrence is not more than 4,000,000 tons, because passage is limited to boats of small draft that can pass through the St. Lawrence canals, now only 14 feet deep. The opportunity for growth in the shipping over the upper St. Lawrence is self-evident.



FIGURE 3.—The harbor of Fort William on the north shore of Lake Superior, the port of shipment of much Canadian wheat consigned to Europe through Montreal. It is the lake terminus of the railways from the great Canadian Northwest. (Courtesy of Natural Resources Intelligence Service, Canada.)

The total tonnage that will use the new waterway is estimated at 20,000,000, which is about equal to that now passing through the Panama Canal.

Moreover, the proponents of the ship channel claim that the movement of freight from the lakes to Europe via the St. Lawrence will reduce the load on the railroads during the fall when shipments of grain are at their height, and thus will tend to prevent congestion at various sea ports and save the expense of providing cars for the peak-load-cars that are idle and produce no revenue during a large part of the year.

THE OPPOSITION

The opponents of the proposed plan doubt the use to any great extent of the canal by ocean vessels. They point to the fact that existing waterways that have been improved by the State and Federal governments are not being used and consequently have had little effect in relieving the railroads. They also call attention to the facts that lake vessels cannot safely proceed to sea and that ocean-going ships cannot carry freight at the low rates now being paid to lake vessels, because of their greater cost of construction and operation. Moreover, dur-



FIGURE 4.—Shipping fruit at Sarnia, River St. Clair, an illustration of the water trade in package freight, even of perishable fruits. As yet the cheaper lake rates do not compensate for other advantages of rail-haulage. (Courtesy of Natural Resources Intelligence Service, Canada.)

ing the winter, when the railroads have their greatest difficulty in moving freight, the St. Lawrence will be closed to traffic and consequently cannot be utilized to



FIGURE 5.—Lower Falls of the Chaudiere River near Quebec. The falls in the tributaries are expected to supply enough electricity for a super-power system to pay a large part of the cost of improving the St. Lawrence. (Courtesy of Natural Resources Intelligence Service, Canada.)

relieve the congestion due to snow blockades, and retarded transportation. It is probable, they say, that more lake boats than at present will carry loads to Montreal (Fig. 2) and will there tranship them to ocean vessels. They contend that since most of the lake traffic consists of coal and ore and that their source and destination are both within the lake zone, —except for the comparatively small amount of coal that might go to Montreal and the small amount of iron ore that might be delivered to tidewater furnaces, —grain only would enter foreign trade (Fig. 3).

Of package freight (Fig. 4), which would have to be depended upon to make up the 20,000,000 tons expected by those favoring the improvement of the channel, very little is now carried on the lakes, although the all-rail rates are higher than lake rates in the same territory. Evidently the cheaper lake rates do not compensate for certain services included in rail-haulage that cannot be furnished by water-transportation.

Even if the canal is not utilized to its

full extent by ocean-going vessels, the advocates of the plan declare that the water power that may be developed on the international section of the St. Lawrence River (about 1,600,000 horse power) will pay the interest on the cost of the entire project, including the canal, the hydro-electric power plants, and the distribution of the power through an area within a 350 mile radius. Moreover, the use of this power at its full capacity will release 20,000,000 tons of coal that would be necessary to produce it, and so may extend the life of our coal resources many years. The utilization of this electric power will thus relieve the railroads of the necessity of providing cars for the transportation of the coal and enable them to furnish better facilities for the movement of freight from those portions of North America not naturally contributory to the Great Lakes-St. Lawrence district.

The opponents of the plan suggest that the freezing of the St. Lawrence will prevent a uniform delivery of electricity throughout the year, and that even if the power that might be developed is as large as that estimated by those favoring the scheme, there is no prospect of its all being sold for many years. No immediate market exists for any large quantity of power in the region contiguous to the upper St. Lawrence in addition to that already used, and there is, besides, abundant undeveloped water power that can be made available in northern New York, New Hampshire, and Maine on the south side of the river and perhaps even more on its north side (Figs. 5 and 6). Moreover, this can be developed as required, thus avoiding the immense loss in interest that will be involved in the construction of large plants, the products of which will not be needed for some time to come. In New York alone 980,000 horse power is available with present installations, in addition to that now in use.

THE GEOGRAPHIC EFFECTS

It is not the intention of this article to determine whether the proposed water-

way from the Great Lakes to the Atlantic Ocean is a practicable one or not. There is no doubt that it could be built and that it would afford a ready means of reaching tidewater from the head of the lakes at a comparatively moderate cost for transportation. It is also certain that it could furnish an all-water route to the Atlantic seaboard for iron ore and perhaps for pulpwood, to Europe and to Mediterranean ports for cargo shipments of grain and from the Pacific and Gulf Coasts to St. Lawrence River and lake ports for lumber and petroleum. Whether it would ever carry noteworthy cargoes of package freight to Europe or of fruit and raw products from South America and the West Indies is doubtful. The Atlantic Coast cities are the natural distributing centers for a large industrial population and bid fair to remain so for a long time in the future. They therefore afford much better opportunities for disposing of miscellaneous cargoes than any point in the lake district and can furnish return cargoes as well. However, if the



FIGURE 6.—Montmorency Falls, another source of water power that will be readily available when the demand by industry for further energy will include these falls in the super-power project now being planned. (Photo by C. F. Jones.)

St. Lawrence is developed in such a way as to provide an abundance of cheap electric power to Ontario and New York, the movement of raw materials to centers in these districts for manufacture into finished products would be increased, perhaps to such an extent that they would develop into great industrial communities. On the assumption that this would be the case, the geographic effect of the waterway may be great.

THE GRAIN TRADE

In any event the reduction in the cost of transporting grain to Europe would benefit the farmers of the States contributory to the lakes. As the price of

courage him to produce more grain. The grain-producing area will be enlarged and the price of grain-producing acreage will be enhanced. Since most of the surplus grain in America is contributed by the country surrounding the lakes, the North Central and Northwestern States and Manitoba, Saskatchewan, and Alberta, will be the beneficiaries (Fig. 7).

Montreal will lose its prestige as the second largest grain port in North America, and Buffalo will lose a large part of its income now derived from the transshipment of grain and the advantage it enjoys as a lake port because of the large number of empty vessels ready to proceed westward with any freight that may

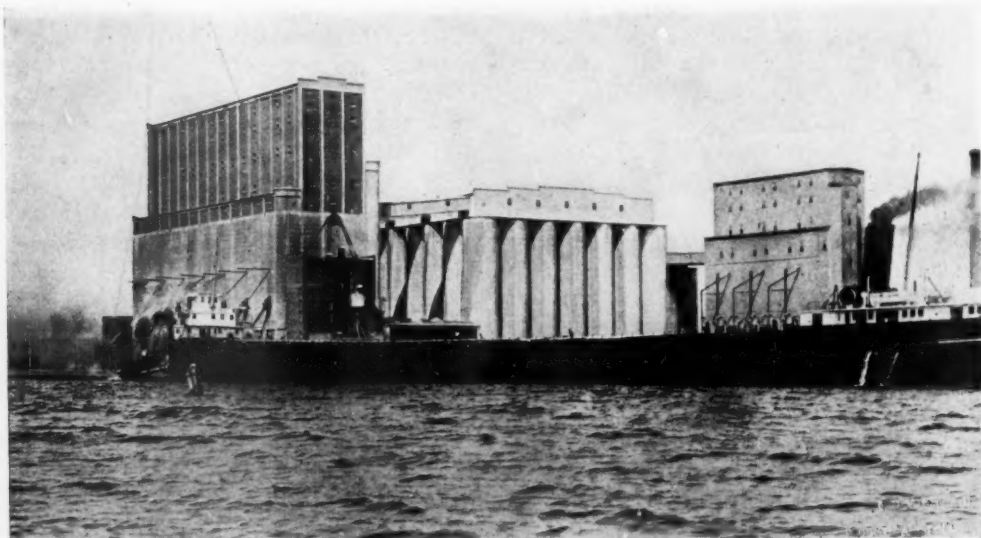


FIGURE 7.—A grain elevator of the Canadian National Railways at Fort William, in which the grain is received from the railways and stored for further transport by water to Europe. (Courtesy of Natural Resources Intelligence Service, Canada.)

grain is determined by the demand for the surplus of the exporting countries, rather than by the size of the crop in any one producing country, and as the price at present is made in Europe, any reduction in the cost of transporting the grain to the consumers can be added to its cost on the farm, without increasing the price at the port of delivery. As a natural result, the profit of the grain grower will be increased and the tendency will be to en-

be offered them. The consequent result of this condition will be that both Montreal and Buffalo will lose somewhat of their commercial importance so far as the grain trade is concerned; and the western cities, Chicago and Duluth, Fort William and Port Arthur will increase in importance, though not to the same degree that the eastern cities will lose, since they are already ports of shipment for most of the grain that goes east by the lakes and will



FIGURE 8.—Coal docks at Port Arthur, where part of the import of American coal is transferred to the railways for the neighboring industries of Canada. Though Canada has great coal reserves, the greater part are situated in the eastern and western provinces; the central provinces must depend upon the United States for much of their coal. (Courtesy of the Natural Resources Intelligence Service, Canada.)

gain only by the expected increase in the aggregate of tonnage that will go to Europe.

THE COAL TRADE

The effect of the improved waterway on shipments of coal probably will be slight (Fig. 8). The coal that goes into the West will follow the same lines as at present. It is probable that there may be some shipments of coal eastward to Montreal and Quebec, but the decrease in the cost of this coal below its cost when shipped by rail may be so slight as to have no effect on the amount that will be used in these cities. A more important consideration is that of the shipment of Nova Scotian coal westward. At present more than half of the 35,000,000 tons of coal consumed in Canada is imported from the United States, most of it being transported by all-rail routes from Pennsylvania, West Virginia and Ohio. In 1915 about 2,500,000 tons

were shipped from Nova Scotia to Montreal and other Quebec markets by the St. Lawrence River route. This amount has been greatly reduced since the war, but nevertheless it is still possible to lay down Nova Scotian coal in Montreal via



FIGURE 9.—A typical ship of the inland lakes in one of the numerous rapids of the St. Lawrence River that prevent free access to the lakes by deep draft vessels. The fall of the water in these rapid stretches is expected to furnish hydro-electric power. (Courtesy of Natural Resources Intelligence Service, Canada.)



FIGURE 10.—The type of vessel now navigating the comparatively small canals along the St. Lawrence River. Because of their simple construction, and the ease of handling them, they constitute an exceedingly cheap method of transporting bulk cargoes. (Courtesy of Natural Resources Intelligence Service, Canada.)

the St. Lawrence in competition with that shipped from the United States by the rail route. With a larger tariff on coal from the States, Toronto, Kingston and the other Canadian cities on the lake might well be provided with coal from Nova Scotia. If large carriers were able to make their way up into the lakes, a boat of 25 feet draft, carrying 8,000 tons, could furnish transportation at a much less cost per ton than a boat of 14 feet draft (the size now plying the upper St. Lawrence) carrying 3,000 tons (Figs. 9 and 10). In times of congestion, moreover, the St. Lawrence route would afford a lane for unimpeded traffic both east and west, and the difficulty that arose a few years ago with respect to the delivery of coal to eastern Canada, New England and northern New York might be avoided.

THE WOOD-PULP TRADE

In the case of pulpwood and wood-pulp the waterway will be more significant (Fig. 11). It is clear that unless new supplies of this material reach the great paper mills of Wisconsin and other western lake States, these large plant investments will be dissipated and the paper-making industry in these States will almost disappear. With cheap access to the forests of Newfoundland, Nova Scotia and New Brunswick, the lives of the

plants might be extended for many years, and if importations from the Scandinavian countries can be made profitable, as now seems probable, the continuation of the industry along the water-fronts of the lakes may be assured for some time.

THE NEIGHBORING INDUSTRIES

Aside from its effect upon the grain growers of the Northwest, the greatest influence of the new waterway upon the welfare of the people occupying territory tributary to the Great Lakes, will be through the greater use by the factories in the Great Lakes district of the St. Lawrence River route for package and car-load freight. These factories need sulphur, kaolin, coffee, cane sugar, rubber, lumber, cocoa, and hides. These commodities now must come by rail. But if deliveries can be made at a lower cost by the all-water route, the cost of the fin-



FIGURE 11.—Loading "half-stuff," wood-pulp material at Fort William. The pulp-wood industry will be materially affected by the proposed waterway. (Courtesy of Board of Trade, Fort William, Canada.)



FIGURE 12.—The area tributary to the improved Great Lakes-St. Lawrence Waterway for coastwise commerce. By R. S. MacElwee and Alfred H. Ritter. (By courtesy of the Ronald Press.)

ished products will be less, and a more active competition will be possible with Eastern producers. Naturally the factories will be enlarged and the number of employees increased, with resulting greater density of population. Probably, there will be a greater concentration of population along the water-fronts than at present, with a possible abandonment of some of the factories in the back country.

One of the strong arguments in favor of the all-water route is that the cost of transshipment at the Atlantic ports will be avoided, because vessels will be able to reach the lake ports without breaking cargo. This argument would be valid if vessels could deliver their cargoes direct to the factories; but this is not possible except for those on the water's edge (Fig. 12).

The conditions for inland factories will not change. There will be no transshipment of freight from vessel to railroad at the sea coast, but there will be a transfer from vessel to cars or to trucks at the end

of the voyage. After the car is loaded at the seacoast, in the case of car-load freight, it is delivered directly to the warehouse, whereas the lake vessel cannot deliver to the warehouse unless this is at the water-front, but must transfer for haulage to the warehouse. The inland factories may be no better off than at present so far as the cost of imported raw materials is concerned, and consequently will be in no better position to compete with Eastern factories. In fact, if imported raw materials are necessary to their production, they will be at a distinct disadvantage, and they will, in time, succumb to their water-front competitors.

In estimating the influence of the waterway upon the industries of the Middle West and Northwest another group of imports—materials that are consumed as food—must be considered. Certain tropical and subtropical fruits and nuts, spices, coffee, sugar, rice, etc., should be cheaper when imported direct than when imported, as now, through the



FIGURE 13.—The area tributary to the improved Great Lakes-St. Lawrence Waterway for commerce with western Europe. By R. S. MacElwee and Alfred H. Ritter. (By courtesy of The Ronald Press.)

Gulf or Atlantic ports. If cheaper, they would be used more extensively, living conditions would be improved and the cost of living would be decreased. This in the long run would be reflected in the cost of manual and clerical labor and consequently in the cost of manufactured products.

It is also possible that a diminished cost of raw material for products consumed in the lake district, but not now manufactured there, might result in the establishment of industries which are now concentrated on the Atlantic Coast.

THE FERTILIZER TRADE

MacElwee and Ritter in their "Economic Aspects of the Great Lakes-St. Lawrence Ship Channel," published by the Ronald Press Co. of New York, state that one of the needs of the territory tributary to the Great Lakes is an abundance of cheap fertilizer, but that its cost is now prohibitive throughout much of the Northwest because of the rail haul of 800 miles or more from the manufactur-

ing centers on the Atlantic Coast. If the materials for its manufacture could be assembled at lake ports, it is believed that its price delivered to the farmer might be reduced sufficiently to enable him to employ it with profit. If this is so, the yield of export crops in the territory tributary to the lakes would be increased and new fertilizer factories would be installed on the lake fronts.

RAW MATERIALS

What is true of the fertilizer industry would be true also of other industries that are now limited to the coast line because of the greater facility with which the coast cities can assemble raw materials. If these could be delivered to the ports on the lakes nearly as cheaply as they are now delivered to ocean ports, there is no reason why there should not be a large increase in the variety of commodities manufactured in the cities on the lakes and the St. Lawrence River, especially at sites where abundant cheap power can be furnished. At present



FIGURE 14.—St. Gabriel, north lock of the Lachine Canal. In the program for the development of the Great Lakes-St. Lawrence waterway, deepened and enlarged canals, and improved locks, constitute a major part of the plan. (Courtesy of Department of Railways and Canals, Canada.)

some of the largest industrial enterprises in the world are situated on the lake front, but they are limited to types consuming mainly domestic raw materials. With free access to raw materials of foreign source, with short rail-haulage to domestic consumers throughout the Mississippi Valley and the central provinces of Canada, and with all-water transportation for export trade, there would seem, *a priori*, to be no reason why extensive manufacture of goods that are now made only on the Atlantic seaboard should not also be made in the lakes district. If this should come about, the lake front and the banks of the St. Lawrence River might become as thickly populated as the Middle Atlantic States.

PEOPLE AFFECTED

Two maps by Messrs. MacElwee and Ritter are well worth reproduction. The first (Fig. 12) shows by shading that portion of the United States that should be able to trade with the Atlantic Coast more cheaply via the St. Lawrence River route than by the all-rail route as at present. If the shading were extended northward into Canada, it would cover the entire area between Montreal and the central me-

ridian of Alberta. The population of the area so shaded would aggregate about 27,000,000, or about a fourth of that of the United States at present. From this, one may obtain some idea of the effect of the improved waterway upon domestic trade, and indirectly upon the consequent redistribution of population density as a result of increased industrial activity.

On the second map (Fig. 13) is indicated in the same way the area within the United States that could exchange commodities with western Europe more profitably by way of the St. Lawrence route and rail from the lakes than via rail and the seaboard. With the addition of all of Canada between Montreal and British Columbia similarly benefited a total of about 50,000,000 people would be affected.

SUMMARY

With the improvement in economic conditions over such a large territory, there would naturally result at the most favorable sites an increase in productive industry to satisfy the demands of the larger population, and to supply commodities for exchange with the Atlantic Coast and Europe. With the growth in

manufactures there would in turn result a greater demand for food, which the farmer would supply either by cultivating more acres or by farming better those he has. In either case, a larger farming population would be demanded. The back country would become more prosperous and land values would rise. The concentration of factory labor along the lake shores would develop local intensive truck farming, like that of New Jersey, Maryland, Delaware and the Virginia coast. The farmer would then no longer depend, as he must now, upon the price his surplus products bring abroad.

With the greater diversification of industry resultant upon the use of the new

waterway, the occupants of the territory tributary to the St. Lawrence and the Great Lakes would become even more prosperous than they are at present. Manufacturing would expand and the industrial population would increase throughout the area.

Near the water front both industry and labor would concentrate; the hinterland would be utilized more intensively in near-urban forms of agriculture; a more balanced diversity of political interests would develop in the new community and the present tension between the political views of the East and of the Middle West would be relaxed.

GEOGRAPHIC FACTORS IN THE DEVELOPMENT OF TRANSPORTATION IN SOUTH AMERICA

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TRANSPORTATION development is regulated by the interplay of two factors: feasibility and demand. Where the demand is great enough, transportation can be provided, apparently in spite of obstacles; but in order to justify transportation development in a region of little demand or of only potential demand, the construction and maintenance must be relatively inexpensive. Thus, transportation and commercial development go hand in hand, and the former is often an index of the latter.

The development of transportation in South America has been relatively slow. South America is an underpopulated continent, with only eight persons per square mile as compared with twelve for Africa or 125 for Europe. With 14 per cent of the habitable land area of the earth, South America has only three per cent of the world's population, and thus offers a large field for future expansion. Already this expansion has begun; more and more attention is being paid to the resources and commercial possibilities of the southern continent. A review of the lines along which transportation has developed since Inca times gives a firmer basis for the understanding of the present and the prediction of the future.

THE INCA ROADS

The more rugged the relief of a region, the more persistent is the influence exerted upon the location of the transportation routes. Thus, in the Andes Mountains, a region of lofty peaks and plateaus isolated by stupendous canyons, nearly the same routes have been followed by Inca roads, Colonial trails, and modern railroads alike. The several ranges of the Andes run approximately

parallel to the coast, separated by stretches of high, graded, peneplain surface, and by the longitudinal rivers which flow in deep young canyons. The lines of communication have shown a tendency to develop parallel to the coast, with short transverse lines at right angles to the coast. In Inca times the longitudinal lines were of greater importance, due to the connection which they afforded between Cuzco and the distant portions of the Empire. They were primarily strategic rather than commercial.

From Cuzco, in southern Peru, there is only one "line of least resistance" along the highlands to northern Peru (Fig. 2). It follows the graded slopes of the upraised but undissected peneplain, keeping to the west of the Apurimac and Marañon rivers, which successively bend eastward in deep canyons across the Central and Eastern Cordillera. The old Inca road followed the route marked by the following towns: Ayacucho, Huanacayo, Jauja, Cerro de Pasco, Huanuco Viejo, Chavin, and Cajamarca. This highland road of the Incas was connected with a coast road by a number of short transverse lines, which descended from the mountains through the short canyons of the Pacific slope (Fig. 7).

When the Incas completed their conquest of what is now Ecuador, they built their road to Quito from Tumbez, at the northern end of this coast road, rather than from Cajamarca in the highlands (Fig. 2). The reason for this lies in the difficulty of passage between Cajamarca and Ecuador. Here the peneplain surface has been exposed to greater erosion because of the proximity of the Amazon main stream, and although the elevations are lower, the graded upland surface gives way to a



FIGURE 1.—A reference map to show the location of important places mentioned in this article.



FIGURE 2.—A transportation map to show conditions in 1500 A.D., at the height of the Inca Empire, before the coming of the Europeans. Only the known Inca roads are indicated.

series of knife-edge divides and deep valleys through which transportation is very difficult. The same conditions which opposed the extension of the highland road beyond Cajamarca also influenced the location of the boundary between the modern states of Ecuador and Peru.

The northern boundary of Ecuador, as well as the northernmost extent of the Inca Empire and its roads, also show the influence of difficult communications. In this section, north of Quito, the longitudinal ranges of the Andes converge in a rugged mountain mass known as the Knot of Pasto. Passage through that region has always been difficult, and proved a stumbling block not only to the Incas, but also to Simon Bolivar when he attempted to hold together in one political unit the newly liberated states of Ecuador, Colombia, and Venezuela.

The Inca roads which led southward from Cuzco were influenced in their location not only by relief, but also by

water resources (Fig. 2). One road ran from Cuzco to Arequipa, and thence southward along the longitudinal valley of Peru and Chile from oasis to oasis. The other southern road crossed the arid Bolivian plateau by a route which probably changed seasonally with the supply of water and which was never well defined. It then crossed the eastern range, following the alluvium-filled valley bottoms just as the trails do today, as far as Tucuman in Argentina (Fig. 8). These roads which crossed regions of shifting sands were not constructed of stone, as were those north of Cuzco. The road to Chile was marked only by a line of wooden guide posts.

COLONIAL TRANSPORTATION

The Spaniards in South America were interested primarily in regions containing gold and silver. Transportation had as its chief duty the bringing of food to the mining cities and the export of the ores to the ports. Thus in the



FIGURE 3.—A transportation map to show conditions in 1820 at the close of the colonial period, after three centuries of Spanish rule had witnessed no change from the original trails and routes of communication.

Andes region, the short transverse lines which were of minor importance during Inca times, became the dominant routes of communication in Colonial times. Trails, travelled only by the plodding but sure-footed mule trains or the llama herds (Fig. 9), led inland from each of the coast ports, each serving a portion of the mineral region. The ports themselves were located close by the piedmont cities, which had been built a short distance inland at the base of the mountains. Trujillo, Lima, Arequipa, Moquegua, Calama, Copiapo, are examples of these oasis cities, each with a port on the harborless coast nearby, and each the center for trails converging from the interior (Fig. 3).

In a region which is capable of supporting only a small population locally, mining activities often result in overpopulation with respect to the local means of subsistence. Such overpopulation results in the development of



FIGURE 4.—A transportation map to show conditions in 1880 when the earliest railways were being built, but before the later extensive construction of railways in Argentina.

transportation, as already stated, not only to carry out the products of the mines, but, equally important, to bring in food for the miners. In such high mining cities as Potosi and Oruro the import of food from lower altitudes was a necessity, and trails tended, therefore, to converge on these highland centers. Potosi, particularly, which in the 17th century had about 160,000 inhabitants, was a center for trails leading from all directions (Fig. 3).

The Pampa of Argentina at this time was of secondary importance when compared to the mineral regions. Agricultural products would not have been able to find an easily accessible market other than these mining centers. The Pampas were used chiefly to raise mules which were needed as pack animals in the highlands. The trail to Salta became one of the most important arteries of colonial commerce, and the commercial city, Salta, did a thriving business at its annual fair. Not until modern ocean



FIGURE 5.—Transportation conditions in 1910, just before the World War.

shipping decreased the distance between the Pampa and the markets of Europe, did the former awaken to its present commercial preëminence.

During this time Brazil was being settled by the Portuguese. Recife, Sao Salvador, Rio de Janeiro and Sao Paulo were developing as centers, and the early roads were radiating from them. The desire for gold was leading the restless Paulistas into the interior of the continent, stretching the borders of Brazil almost to the base of the Andes. One of their routes crossed the Alto Parana River and the Central Plateau to the Paraguay River above Asuncion, and thence to the gold at Cuyaba, while another followed the divide along the plateau through Goyaz and Cuyuba, as far as Matto Grosso (Fig. 3). From Rio a number of roads ran inland to various parts of the Empire. As a whole, South America was poorly provided with transportation, so that a factor of great importance in the early history of many sections of that continent, even close to the coast, was isolation.



FIGURE 6.—Conditions at the close of 1923. Great advances have been made within a century, but until still more railways are built to the more inaccessible regions, the resources of South America can not be adequately developed.

EARLY RAILROAD DEVELOPMENTS

The earliest railroads in South America appeared in response to the demand for outlets by productive hinterlands. Since production in colonial South America was generally greatest in mining regions, most of these early lines connected mining centers with ocean shipping. The earliest railroad of all was built in Venezuela, from Tucacas to the famous copper mine at Aroa. This line was built in 1835, and although it was abandoned shortly after, it has the distinction of being the first railroad on the continent. Railroad development, however, did not begin in earnest until 1850. Several lines appeared about this time on the Pacific coast, reaching mining centers or with mining centers as their objectives.

Commercial development, however, increased rapidly in a few purely agricultural regions which specialized in the production of a single crop. For ex-



FIGURE 7.—A narrow trail in the Peruvian montaña, quite similar to some of the old highland roads of the Incas.

ample, the great prosperity of the sugar plantations in British Guiana, under the British system of contract labor, caused the construction of what is often spoken of as the first railroad in South America. This line ran from Georgetown along the

coast through the sugar plantations. Another purely agricultural railroad was built from Santos, up the rain-drenched slopes of the Serra do Mar, to Sao Paulo in Brazil. The great productivity of Sao Paulo created an early demand for



FIGURE 8.—The wearisome trails of eastern Bolivia follow the flat valley floors during the dry season; during the rainy season when the valleys are flooded by the torrential mountain rains, transportation is interrupted for long periods.



FIGURE 9.—The llamas are still used as beasts of burden in many parts of western South America. This little Indian village in southeastern Bolivia has a considerable herd. The llamas are adapted to the rigorous conditions of relief and climate that characterize the region.

transportation in this section, in spite of the obstacles which the geographic conditions had placed in the way.

Although this Santos-Sao Paulo line gave the coffee region access to the world markets, the student should not believe that the geographic factors of difficult accessibility had been set aside. In this case, as in many others, these factors continue to operate, in a less noticeable way, to be sure, but nevertheless persistently. The cost of the transportation—which results simply from the translation of the geographic condition to an economic condition—is added to the price of the coffee, and is carried by the consumers of coffee all over the world. It is always well to remember that products from regions of difficult accessibility, however well transportation may be developed, add their burden to the general cost of living in proportion to the original difficulty of reaching them.

Returning, however, to Figure 4, the advances in railroad development which had been made up to 1880 are shown there. By this time there were a number

of short lines running inland from the Pacific coast, although the longitudinal connections had been completed only in Middle Chile. The importance of the nitrate fields of Northern Chile can be seen in the several lines which cross the coast range in that region (Fig. 10). The early importance of the route between Argentina and Peru by way of Salta and Potosi is revealed in the railroad which connected historic Tucuman and the Andean piedmont to the north with ocean shipping at Rosario. The railroad nets which today characterize the hinterlands of Buenos Aires, Sao Paulo, and Rio can be seen even in 1880 in their infancy. The first railroad and the beginning of Argentina's agricultural growth came in 1857. On this map, also, two purely military lines can be seen, one on either side of the Uruguay River, from Salto to the navigation above the rapids. These were not justified by any economic demand.

Transportation in the Pampa region beyond the railroads was difficult. The flatness of the land, which made conditions for railroad construction so easy,

were not favorable to road building, particularly as there was no stone for road material. Because the region is in extreme physiographic youth, the drainage is imperfect, and during the rainy season much of the country is swampy and impassable except on horseback. For this reason, even today rural Argentina lacks good roads, and before the coming of the railroad successful agriculture was practically impossible.

Navigation on the three big rivers of South America was developed in early times. But the importance of the Amazon and Orinoco Rivers was mini-

of the most important causes of the isolation of Paraguay, an isolation which plays such a large part in the interpretation of the history of that country.

TRANSPORTATION UP TO 1910

Buenos Aires has become South America's largest city because of its close connection to a large and productive hinterland (Fig. 5). The large railroad development in the Pampa is a result of the agricultural awakening of that region in response to a greater demand in Europe and North America, and to better transportation facilities on land and



FIGURE 10.—The railroad bed across the desert plains of northern Chile, a monotony of landscape and lack of interest. The nitrate fields which this road taps are among Chile's most valuable resources.

mized by the tropical climate which retarded the settlement of the region. The Parana River is the poorest of the three as regards navigability (Fig. 11). During low water sand bars clog the channel and during flood water, the old channels are wiped out, and the banks are heavily eroded by the rushing torrent (Fig. 12). In the days of sailing ships it used to take four months or more to reach Asuncion from Buenos Aires. Transportation to the interior of the continent, therefore, avoided the river route, following instead trails constructed as far as possible from the marshy regions close to the stream (Fig. 4). This is one

sea. In the Pampa itself, the denser portions of the railroad net are in the wheat and corn growing sections, while the southeastern portion, where the lines are farther apart, is still primarily a grazing region held in large estates.

There are certain important obstacles, however, to railroad development in the Pampa which should be mentioned. The lack of coal is a serious handicap, which became particularly noticeable during the war, when English coal was unable to reach Buenos Aires in its accustomed quantity. Another handicap in the Pampa is the heavy demand for grain shipments during the harvest season, and

the relatively few shipments at other seasons. Because of the dry harvest season, there has been no spur of necessity to set up country grain elevators as in the United States, so that the grain is all shipped to the ports as fast as the railroads can haul it. Furthermore, because of the sparse rural population, and because of the relatively low standard of living, very little merchandise is available for return freight from the ports to the rural districts. These obstacles, however, were offset by the

communication was never insistent. The trans-Andean railroad was poorly constructed, especially on the rainy western slopes, and is often closed during the winter months by the heavy snows.

On the Pacific coast a longitudinal railroad had almost been completed in Middle Chile, not quite reaching Puerto Montt (Fig. 5). North of Valparaiso, however, the coast range and the Andes meet, pinching out the longitudinal valley. Transportation through this area had proved a stumbling block to the



FIGURE 11.—La Guayra Falls on the boundary between Brazil and Paraguay, one of the effective barriers to steamship traffic up the Parana River, and a potential source of water power.

cheap construction and maintenance and by the heavy traffic which accumulated all along the lines.

In 1910 the first trans-Andean railroad was completed between Mendoza in Argentina, and Valparaiso and Santiago in Chile. The railroad crosses the Andes by the old Uspallata Pass. This pass was used for many centuries for practically the only route between Chile and Argentina, and because of the similarity of products on either side of the mountains, the demand for better means of

longitudinal communications for many years. North of the Cabillo Barrier, as this section has been named, the short transverse lines penetrated the coast range from the many ports, but remained as isolated fans. Only in a few places, notably in the nitrate region, was the north-south line apparent (Fig. 5). In Peru, also, there were many short transverse lines (Fig. 13), and only a few stretches of the longitudinal railroad, the latter following very closely the route of the old colonial trails and the earlier



FIGURE 12.—A comfortable, but slow way, of traveling on the Parana River. The sidewheel steamers resemble those of the Mississippi and its tributaries.

Inca roads. (Compare with Figs. 2 and 3.)

In the tropical regions, the Spanish colonists habitually placed their chief cities and their centers of production on the elevated plateaus. This tendency brings about a problem of transportation, because the same elevations which give asylum from the fever-infested lowlands, render the asylums difficult of access from the outer world (Fig. 14). Thus the transportation problems in the tropical

mountainous countries have been involved primarily with the connection between the coast ports and the highland cities. In Ecuador the only important railroad in the country runs from the Guayas River, opposite Guayaquil, to Quito on the highlands. Like so many of the lines in these tropical countries where the production of the hinterland is not sufficient to make a rapid development of transportation economically possible, the Guayaquil-Quito line was a great many years in the building. In 1880 (Fig. 4) the lowland portion had already been constructed, but it was not until 1909 that the line finally reached Quito.

In Colombia transportation to Bogota has always been closely connected with navigation on the Magdalena (Fig. 15). But with the intention of connecting the capital with the Pacific ocean at Buenaventura, and thus avoiding the unsatisfactory navigation of the river, the railroad from Bogota reached the Magdalena Valley at Girardot, so that it might easily ascend the Cordillera Central from there to the Quindio Pass. Meanwhile, navigation on the Magdalena is interrupted by the Honda



FIGURE 13.—The railway from Lima back into the mountains. Most of the minerals of Peru reach the coast over this route.



FIGURE 14.—The Rimac Valley in Peru, the gateway by which the railway finds its way through the mountains from Lima to Oroya.

rapids some distance below Girardot (Fig. 5). A portage railroad is necessary there, and another short haul on the Upper River steamers, in order to reach the Bogota railroad. The line should have been built to Honda, so that several extra handlings of freight could have been avoided. Until the project of which the present railroad is a part is completed, the line will not serve its purpose of opening Bogota to the world's commerce. Freight is still largely handled over the mule trail from Honda (Fig. 5).

In Venezuela there are a number of short railroads, connecting, or projected to connect, each provincial capital with a seaport. Caracas and Valencia are connected with the ports of La Guaira and Puerto Cabello respectively, and a little east of the Valencia railroad the old Tucacas-Aroa line has been extended to Barquisimeto. In the Maracaibo lowland, however, three of the lines, projected to reach the provincial capitals, have failed to reach their objectives (Fig. 5). None of the lines in the country are really prosperous. The



FIGURE 15.—A Colombian village along the Magdalena River, where the flood plain is a region of rich soil and tropical products.

common two-wheeled mule carts are able successfully to compete with the railroads, even on the La Guaira-Caracas line. Probably the railroads in Venezuela represent an over-development of transportation. Roads would be more suited to the economic needs of the country than the railroads. In other words, the demand is not yet sufficient to pay for the high cost of railroad construction and maintenance. Venezuela at the present time is engaged in a systematic program of road construction, a program which is well suited to the economic stage of the country, and which might well be followed by other tropical countries, instead of the more pretentious schemes of railroad development.

In 1909 the peak of prosperity in the rubber region of the Amazon had been reached. Depending for its development on a single product, the transportation along the great network of navigable streams had been well organized. Large river boats covered the main streams, and the upper rivers were followed by many smaller power launches which collected the rubber and carried mail and passengers. On the map (Fig. 5) the upper limits of launch navigation are given for the high water period, although during the low water periods the points reached were farther downstream. The intervening distances were covered by canoe. Ocean ships were making regular calls at Belem, Manaus, Iquitos, and Porto Velho. But this prosperity began to give way to depression in 1910. The plantation rubber from the Malay Straits region began to outstrip the wild Amazon product. In 1909 the Amazon produced about 40 per cent of the world's rubber; in 1922 it produced only a little over 5 per cent. From now on the Amazon must look to a greater variety of products for its prosperity and cannot depend on the "black gold" of former times.

PRESENT DAY TRANSPORTATION

The World War and its resulting economic turmoil has affected all parts

of the world. Transportation development in South America was retarded in almost all the countries, and until recently there has been little activity in railroad construction since 1914. A number of important constructions were completed, however, before 1914, which appear for the first time in Figure 6.

The network of railroads on the Argentine Pampa was added to in places, and was extended northward into the forests of northern Argentina. The Upper Parana Lowland, particularly that portion known as the Gran Chaco in eastern Bolivia, finds itself still with



FIGURE 16.—The trail that leads through one of the forests of eastern Paraguay, where timber resources of great value await commercial development, and by which the products of the Grand Chaco may reach market.

poor means of access to the outer world (Fig. 16). This region is potentially very productive, and now three railroads have reached its borders, each striving to be the one over which its products will reach the world markets. Bolivia owns a large part of the territory, although a part of it is contested with Paraguay, and Bolivia's expensive railroad from Cochabamba to Santa Cruz is being actively pushed (Fig. 17). The heavy cost of construction and maintenance on the rainy slopes of the Andes, however, will diminish the value of this line in compe-

tition with those from Argentina and Brazil. The Brazilian line was built from Sao Paulo to Corumba on the Paraguay River, more as a strategic line than in answer to any immediate economic demand. It has, nevertheless, reached the borders of Bolivia and is a competitor for the traffic of the Gran Chaco. The Argentine line has reached Embarcacion, near the northern border of Argentina. Further extension northward is prohibited by the Bolivian government at present. The lowland route to Buenos Aires, the contrast of products

solved the problem of crossing these large rivers where for many reasons bridges are not practicable. Until the ferry was brought into service, the Parana served effectively to isolate its northern shores and to limit the rapid agricultural developments to the Pampa shore.

No additional trans-Andean railroads have been constructed, but several projects are nearing completion. In the north the contrast of products between Argentina and Northern Chile is very great, and the demand for a railroad between Salta and Antofagasta has at



FIGURE 17.—Atocha, the railhead in eastern Bolivia, whence pack train and river boat constitute the means of continued progress for the traveler.

between the Gran Chaco and Temperate Zone Argentina, the fact that any large supply of labor for the development of the Chaco will probably come from Argentina, and the importance of Buenos Aires as a ready market or an export port for the Chaco products all seem to point to the Argentine line as the likeliest winner of this competition.

Another northward extension from the Pampa is the line which now reaches Asuncion in Paraguay. This line crosses the Parana and Alto Parana Rivers by train ferries. The ferries appear to have

last resulted in such a project being undertaken. But this line would stimulate only Argentine exports to Chile, and could never have received the support of the Chileans were it not for a similar trans-Andean project in the south. The latter runs from Pua on the longitudinal railway of Chile, over the Pino Hachado Pass to Neuquen, and thence to Bahia Blanca in Argentina. This line will provide an export route for Chilean coal, located near Concepcion and Lebu, for which there is a ready market in Argentina, owing to the complete lack of

coal in that country. Thus Argentine exports in the north are balanced by Chilean exports in the south. Both these projects are nearing completion.

In 1914 the Cabildo Barrier, north of Valparaíso, was at last crossed by a railroad, and the same year the whole length of the Chilean *red central* was completed from Puerto Montt to Pisagua (Fig. 6). The line is primarily strategic, since any longitudinal railroad on the Pacific coast must necessarily suffer from competition with the ocean shipping. The line was not completed to Arica. Lines from Arica and Antofagasta, how-

cally a landlocked state, its economic prosperity will continue to grow as these new lines are utilized, and as new mining regions are opened up.

Peru's financial condition prohibits any very important railroad ventures. A new line has, however, been completed down the Urubamba Valley from Cuzco, which provides the first all rail access to the rich *montaña* region. With the exception of this line railroad transportation in Peru has been limited to the belt west of the Central Cordillera; east of that range the country has been largely isolated. The reason for this lies in the



FIGURE 18.—Modern transportation in eastern Bolivia, little advance from Incan and pre-Incan days.

ever, were constructed to La Paz, giving the Bolivian capital its first direct rail outlet to the sea.

The railroad pattern in Bolivia is strongly reminiscent of the Colonial trails in that region (Fig. 18). The connection between La Quiaca in northern Argentina, and Uyuni in Bolivia, which will soon be completed, will follow very closely the old colonial trail (compare with Fig. 3). When this line is opened, La Paz and the Bolivian mining centers will have three rail outlets to the sea, and although Bolivia may remain politi-

cally a landlocked state, its economic prosperity will continue to grow as these new lines are utilized, and as new mining regions are opened up.

In Colombia there has been considerable activity in railroad construction, particularly in the last few years. The Buenaventura to Cali line has been completed, and has been extended up and down the Cauca River (Fig. 6). At the present time only the Central range of the Andes lies between the completed portions of the Bogota to Pacific railroad,



FIGURE 19.—On the Magdalena River. Most of the boats that ply on the South American rivers use wood for fuel, and long stops to take on fuel characterize river journeys. "Stern-wheelers" only can navigate the shallows.

so that the latter project may become a reality within a few years. In the meanwhile, however, Bogota still suffers from inadequate transportation. If the tropical countries develop as food-producing regions to satisfy the demands in the growing population centers of the Intermediate Zone, Colombia will find that the Magdalena Valley will provide a better route of transportation than the Pacific railroad (Fig. 19). The former leads directly to the Caribbean, and from the Magdalena mouth access is easy to the great future markets in response to which these countries will eventually develop. Already the beginnings of this inter-zonal trade have appeared in the banana railroad and docks at Santa Marta in northern Colombia.

In the Amazon Valley the decline of rubber has left many transportation projects stranded. The Madeira-Mamore railroad connecting the Mamore River with ocean navigation at Porto Velho, has been completed to Guajara Mirim, although the projected terminus at Riberalta has not been reached, and there is no immediate prospect of its being reached. River navigation remains about as in 1910, the slow development being characteristic of the greater part of the tropical lands.

CONCLUSIONS

With this brief survey of the historical development of transportation in South America, let us glance ahead at the developments which are bound to come

when South America is more heavily populated than today, and when the markets of the already established centers of population are even more insistent than now.

The Pampa of Argentina will undoubtedly remain the economic center of the continent, although its tributary area will probably expand north and south. With the increased use of the pastures of Patagonia, Bahia Blanca should become of very great importance as a natural focus point for railroads in the southern Pampa and in northern Patagonia. Railroad lines will probably be built along the Andean piedmont into southern Patagonia, although the farther these lines are pushed, the greater will be the competition with ocean shipping.

Brazil will undoubtedly begin the construction of railroad nets similar to those in Sao Paulo and Rio, farther south in the states of Santa Catharina and Parana. The work of settling the more accessible portions of the Brazilian Highlands will occupy Brazilian energy for some time, so that the competition with other countries for the Upper Parana Lowland and the interior of the continent will not probably be very great. The tendency on the east coast will be for transportation to concentrate on a few favored ports to the detriment of other less well situated ports. One exception to this is the port of Victoria, which at present is small, but which will see considerable prosperity in the future. Because of the heavy grades, the curves, and the tunnels on the railroads from Rio to the iron fields of Minas Geraes, the railroad to Victoria which escapes the higher mountain ranges will probably be used for the export of the Brazilian ore. Victoria and Santa Cruz, 31 miles north of it, may some day rank with the world's great iron ports.

On the west coast the railroads will continue to develop slowly, following the pattern which was revealed before the coming of Europeans by the Inca roads. Extensive longitudinal communications will never be profitable except for mili-

tary purposes, owing to the competition for through freight with ocean shipping, and to the almost complete lack of local freight other than minerals, which seek the shortest routes to the coast. Thus projects such as the Pan American railroad, although so commonly mentioned, and so often included in railroad maps of South America, would never be economically practicable.

The tropical countries will not develop rapidly until the growing demand for food products in the Intermediate Zone becomes insistent. When this demand is sufficient to make it possible to bear the cost of development in these remote lands, and when the problems of tropical labor have been solved, then the northern part of South America will come into its own heritage. Then the great network of navigable rivers in the Amazon basin, which make it possible for ocean vessels to pass into the interior of a vast poten-

tial food-producing region, will be fully appreciated and utilized. The future generations, too, which must carry the additional economic burden of developing these lands, will count as a very important resource such easy and inexpensive means of access to the interior of a continent.

In closing, mention should be made of the possibilities of airplane transportation. In Colombia, regular airplane routes have already been established between Barranquilla and Cartagena (Fig. 20), and inland points. Airplanes are not adapted to carrying bulky articles. They will be used primarily for materials of large value per unit weight, and as such are not available for the transportation of raw food or mineral products. Nevertheless, in the face of the difficult problems of tropical mountain transportation, the airplane is being watched with considerable hope and interest.



FIGURE 20.—Cartagena, one of the important ports of northern South America, constitutes an outlet for the products of the Magdalena Valley.

BOOK REVIEWS

The Bureau of Foreign and Domestic Commerce has issued a number of publications within the last month which are of great value to the geographer. A number of these are included in the new Trade Promotion Series which incorporates publications formerly appearing as Special Agents Series or as Miscellaneous Series.

The Transportation of Pacific Coast Perishables, Trade Promotion Series No. 12, price 20 cents, by A. Lane Cricher of the Transportation Division, treats of the problem of transporting these fruits raised on the Pacific Coast to the consuming markets in the East. It indicates the various difficulties in the way of sending such shipments and the methods by which they are brought to the consuming markets in good shape. This bulletin contains maps showing the movements of apples, canteloupes, grapes, tomatoes and celery, as well as a larger map which indicates the primary destinations for California products.

The Crude Rubber Section of the Rubber Division of the Bureau, under the direction of Dr. H. M. Whitford, has been carrying forward a study of the possible rubber producing areas in the Middle East. A very able discussion of *The Plantation Rubber Industry in the Middle East*, Trade Promotion Series No. 2, price 50 cents, by David M. Figart, has just appeared. This work is based upon thorough field studies. It treats of the conditions in the countries of the Middle East such as Ceylon, India, the Pacific Islands, Malaya, and the Netherlands East Indies, and analyzes the possibilities as well as the difficulties connected with producing rubber in this area. It contains well organized statistical material on the rubber industry, as well as a rather complete bibliography. Maps, graphs and illustrations lend point to the discussion.

Lumber Market in The Netherlands, is the title of Trade Promotion Series No. 4, by Axel H. Oxholm, Chief of the Lumber Division, price 45 cents. This discussion treats of the possibilities for lumber production in The Netherlands and the extent of the market there for this product. It shows the lumber trade by ports in that country, as well as the various types of lumber which are consumed there. The statistical material and illustrations are excellent.

Tobacco is one of the most important commodities in the export trade of the United States. *International Trade in Leaf and Manufactured Tobacco*, Trade Promotion Series No. 7, price 35 cents, by T. L. Hughes, is one of the series of special studies prepared under the direction of Dr. Frank M. Surface in connection with the survey of world trade in agricultural products. This bulletin gives a clear idea, not only of market

conditions, but of possibilities for production in the various countries, and contains carefully collected and detailed statistical material.

Trade in Philippine Copra and Coconut Oil, by E. D. Gothwaite, Trade Promotion Series No. 11, price 20 cents. This study includes a discussion of geographical conditions in the Philippine Islands, the distribution of population there, merchandising methods and transportation facilities. It also presents an able analysis of the copra industry, the Philippine coconut oil industry and world consumption of coconut oil. A map shows the producing areas for copra in the Philippine Islands. Several graphs and illustrations further add to the value of the bulletin.

It is often difficult to find material on a country like Algeria. *A Commercial Handbook on Algeria*, by Chester Lloyd Jones, United States Commercial Attaché at Paris, and Edward A. Dow, United States Consul, Algiers, helps fill the gap in information relating to this area. It is Trade Promotion Series No. 8, price 15 cents. The general economic conditions are given thorough consideration. These include climate, population, transportation, communication and fiscal developments. The next part of the bulletin treats of agricultural methods and products, live stock, the production of textile materials and fibers, minerals and foreign trade. Considerable attention is given to the possibilities for marketing American manufactures in this area. An excellent outline map shows the railroads and roads in this country, and a number of pictures help the reader to get a clear idea of the conditions in the area.

International Trade in Cotton, by Leslie A. Wheeler, has just appeared as Trade Promotion Series No. 13, price 15 cents. This bulletin presents a comprehensive survey of cotton production in all the areas which raise this product as well as complete statistics of world production. The exports and imports for each country are analyzed carefully and a section on international trade statistics presents a complete picture of the movement of this commodity in world markets.

For the geographer interested in ocean trade, a revised edition of *Government Aid to Merchant Shipping*, by Grosvenor M. Jones, Chief of the Finance and Investment Division of the Bureau of Foreign and Domestic Commerce, Special Agents Series No. 119, price 50 cents, presents a thorough study of subsidies, subventions and other forms of state aid in the principal countries of the world. It is an exceptionally valuable handbook on the subject.

Brazil, An Economic Review by States, by Richard C. Long of the Latin American Division of the Bureau of Foreign and Domestic Commerce,

has just appeared as Trade Information Bulletin No. 349, price 10 cents. This bulletin presents a careful analysis of economic and geographic conditions in the several states of Brazil. It shows for each state the possibilities for agricultural, mineral and manufacturing development, the market areas and railroad lines.

All of the above publications may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D. C.

Time Zone Chart of the World, Hydrographic Chart No. 5192, edition 4th of May, 1925, price 50 cents.

The Hydrographic Office has just issued a new edition of the Time Zone Chart. It is considerably larger than the earlier map, and brings down to date time conditions throughout the world. It shows by appropriate colors the countries which have adopted the Hourly Time Zone System, countries where local time differs one-half hour from the meridian zones, countries that have not yet adopted the zone system in any form, and areas where their local time is not known or no local time is kept.

By means of this chart it is possible to know the time in practically any part of the world. It is an excellent publication, very carefully prepared and accurately drawn.

The League of Nations, 1925 map, compiled by Dr. Laura H. Martin, published by the University of Chicago Press, price 10 cents. Many people have a very indistinct idea regarding the relation of the various countries of the world to the League of Nations. Dr. Martin has shown by a series of well chosen colors those countries which are members of the League; those which cooperate unofficially with the League, and the International Labor Office; the states which signed but have not ratified the covenant, and the countries which are members of the Labor organization only. Mandated areas and states not in the League are shown by appropriate symbols. The boundaries of this map have been very carefully checked and are correct. The map is drawn upon the Goode homolosine equal area projection, and shows in addition to political relations the comparative population of the countries by circles. This is an extremely worth while and valuable publication.

HELEN M. STRONG.

LAHEE, ARNOLD W. *Our Competitors and Markets*. xvi and 477 pp.; maps, diagrs., sources of information, bibliography, and index. Henry Holt and Company, New York, 1924. \$4.00. 9 x 5½ inches.

This work opens with a summary discussion of the economic relationships of the United States with other important regions of the world, together with recent economic development and probable future trend; then follows a concise survey of the key industries of several other important nations with the factors within those

nations making for economic growth, stagnation, or decline. Many geographical, climatic and economic facts of interest and importance are woven together in a readable way. Ingeniously contrived maps, charts and diagrams present these facts graphically and concisely.

Though the book contains a good bibliography, the exact sources of information contained in the text are not cited. The discussion of the Australasian land policy (p. 384 and elsewhere) indicates inadequate comprehension of the lessons to be derived from a study of the development of our own Western lands in the last century.

The work, as its title indicates, is an approach to world economic problems from the point of view of our own private and national economic interest. It is a frank evaluation of the several regions of the world as fields for industrial exploitation or as sources of commercial gain or loss as a result of trade. It is the type of study that should be of considerable value to those groups of business men who are seeking convenient compendiums of information concerning lands beyond our own national borders.

Its imperialistic trend, however, will hardly convince our national neighbors that our concern in their affairs is entirely disinterested. The discussion of Central American intervention, for example (pp. 553-557), or the statement that Mexico is "the richest undeveloped accessible country on the earth" (p. 260) may be welcome news to economic imperialists within the United States, but is hardly the type of discussion that creates confidence on the part of these nations in their larger brother. The discussion of the Japanese question also seems unduly dogmatic and chauvinistic. The value of the work to students is increased by an excellent and detailed index.

S. J. BRANDENBURG.

RECORD, SAMUEL J. and MELL, CLAYTON D. *Timbers of Tropical America*. xviii, 610 pp.; 51 pl. Yale University Press, New Haven, Conn., and Humphrey Milford (Oxford University Press); London, 1924. \$10.00.

For more than 400 years the American tropics have supplied the world with a great variety of forest products. Brazilwood, *lignum vitae*, logwood, mahogany, rosewood, Spanish cedar, letterwood, satinwood, lancewood, greenheart, and many other specialty woods have long been utilized by the industries of Europe and America. Of even greater value has been the production of other forest materials, including tannin, fibers, gums, resins, oils, nuts, medicinal barks, and rubber. Yet Latin America for 300 years has depended largely on North American conifer forests for its construction timber. Excepting firewood, all Latin America uses less timber in a year than the United States consumes in two weeks, and it has been generally cheaper to buy northern softwoods than to get out native timber.

In consequence, the idea has prevailed that the

tropical forests are composed of trees yielding precious woods or special products, and other timbers too hard and heavy for industrial use. Information has come largely from explorers who lacked technical knowledge of timber, or from botanists who were more interested in taxonomy than in the economic utility of the trees. They reported so many kinds of timber—more than 2500 from the Amazon region alone,—that the prospects for systematic utilization seemed most discouraging.

In recent years, however, the growing scarcity of various hardwoods as well as common construction timbers in northern countries has stimulated interest in the forests of the tropics. The first essential is knowledge of the important woods, their distribution, abundance, and physical and mechanical properties. Considerable information for individual regions of Asia, Africa, and South America has already been published, but no work on Latin America as a whole was available until the School of Forestry of Yale University undertook a comprehensive study of the problem.

"Timbers of Tropical America" is, as the authors state, "necessarily of the nature of a general reconnaissance" of the available published material, supplemented by original observations and studies. The section by Mr. Mell gives an excellent general description of the individual countries and their forests. There is one apparent misstatement, that all of the pine timber in British Honduras is privately owned. This does not agree with official reports, which state that most of the pine forest is Crown property.

In the main part of the book Professor Record takes up the trees and woods of 75 families that grow naturally in tropical America, giving for each family a brief statement of its size, distribution, economic importance, and the general structural features of the wood. More detailed descriptions of the important genera and of some of the principal species follow. A 50-page index of common and botanical names is a useful addition.

The only important conifer forests are those of Mexico and Central America and the *Araucaria* of Brazil, which covers an area half as large as southern pine originally occupied in the United States. There are, however, large supplies of other woods suitable for construction purposes, including among others various species of the Lauraceae, Leguminosae, Sapotaceae, Lecythidaceae, Apocynaceae, Bignoniaceae, Vochysiaceae, and Meliaceae. *Cedrela*, Spanish cedar, which is said to be the most widely distributed tree of tropical America, furnishes excellent construction timber. Its ease of propagation and rapid growth make it a most promising tree for commercial planting.

It is concluded that "the forests which offer the best opportunities from the standpoint of supplying the United States in the early future, are

located in Mexico, Central America, northern South America, and the lower Amazon." It is to be hoped that large-scale commercial development of these forests will be attended with due regard for their perpetuation, so that they may always be a source of wealth to Latin America and the world. By coöperating with other agencies in the United States and in Latin America in technological and silvicultural research looking to that end, Yale has an exceptional opportunity to render distinguished public service that will far transcend our national boundaries.

W. N. SPARHAWK.

GRUBER, JOSEF. *Czechoslovakia*. XIX and 256 pp. New York, The Macmillan Company, 1924.

This book bears as its subtitle, "A Survey of Economic and Social Conditions." The work is edited by Dr. Gruber, and translated from Czech manuscripts by a committee of three persons.

The introduction and each of the nineteen chapters is written by a different author, an expert in the field of knowledge treated in the chapter; for example, the chapter on "Population" is written by the "Councillor of the State Bureau of Statistics"; the chapter on "Forestry" by the "Councillor of the Ministry of Agriculture"; the chapter on "Water Power" by the "Division Chief in the Ministry of Public Works"; the chapter on "Railways" by a "former minister of Railways"; and the chapter on "Labor Legislation" by the "Division Chief in the Ministry of Social Welfare."

The book has been so well planned, prepared, and edited that the reader finds as unified treatment of Czechoslovakia as if the work had been written by one person. The book is of interest to students of geography, history, or economics, who wish authentic and recent information concerning one of Europe's most vigorous new countries. Each chapter deals specifically and authoritatively with the subject in hand. The facts concerning Czechoslovakia are set forth definitely, and related directly to similar topics in adjacent countries and to the world.

The scope of the book is indicated by its nineteen chapter headings: Population, Agriculture, Forestry, Land Reform, Coal, Water Power, Industries, Foreign Trade, Customs Policy, Railways, Postal Service, Banking, Currency, Government Finance, Labor Legislation, Social Welfare Policy, Child Welfare, The Housing Question, Crime. The American reader discovers how these questions of economic and social life are handled by the authorities of a new country in the process of organization in an area having a dense population, an age-old history and civilization, and valuable and varied natural resources. The problem presents aspects vastly different from the development of the new lands of the United States during its one hundred and fifty years of independence. The chapters on

Agriculture, Forestry, Land Reform, Coal, and Water Power, show that the problems of the new Republic of Czechoslovakia are the problems of a region already mature in the handling of natural resources for the support of a relatively dense population. The problem is not that of getting new settlers for new and virgin lands, but the problem of securing fair play for all the elements of a large population in a region with centuries of economic and industrial development within the area.

As one reads chapter after chapter of this interesting volume, he appreciates the thoroughness with which the responsible authorities of this new Republic have studied their special fields and how carefully they have planned for a sound and progressive development of their new Republic in all lines of modern economic, industrial and social welfare.

Books of similar nature, written by experts for each of the newer countries of Europe, and for some of the older countries, printed and distributed by an American publishing house, and widely read by American citizens, would do much to give Americans the point of view so necessary to understand our European friends in relation to the United States and to each other.

DOUGLAS C. RIDGLEY.

JONES, WELLINGTON D., and WHITTLESEY, D. S.
An Introduction to Economic Geography.
xxxvii and 375 pp.; maps, diagrs., ill.,
index. The University of Chicago Press,
Chicago. 1925. \$5.00. 6½ x 9½ inches.

An Introduction to Economic Geography will be welcomed by all teachers and serious students of the subject. The result of much careful research, both in content and method, it will fill a long felt need on the part of teachers of elementary college geography.

The initial chapter deals with the "Scope of Economic Geography" in which the authors state that "economic geography is concerned with man quite as much as with the natural environment, and that man may make and does make a choice as to how his economic life is ordered. It should not be forgotten, however, that nature sets broad limits within which men can live and work successfully." The remaining chapters treat in detail the several elements of the natural environment, establishing their distribution and indicating specific ways in which they influence economic activities.

The organization is distinctive. Each chapter consists of three parts,—exercises, textual materials, and illustrations, but they are so interdependent that they seem a unit. The questions are arranged systematically and are geographically and pedagogically sound. The textual matter comprises partly original contributions and partly well selected references from specialists in various fields of geography and related subjects. The diagrams are excellent and appro-

priate. Probably no text to date so well merits praise in its choice of graphs, diagrams, maps, and photographs. Here is an excellent example of photographs, taken by a geographer, in this case the senior author, to emphasize certain geographic principles.

From the point of view of the teacher, probably no portion of the book will make a stronger appeal than that on climate. This section by its use of maps and relevant text enables the teacher to really put climate across. It is undeniably "teachable." Since the classification of climate is based on observed facts, and not on causes, it lays itself open to severe criticism by those who do not look upon Geography merely as human ecology.

LANGDON WHITE.

SMITH, J. RUSSELL. *North America: Its People and the Resources, Development, and Prospects of the Continent as an Agricultural, Industrial, and Commercial Area.* viii and 849 pp.; ill., diagrams, maps, index. Harcourt, Brace and Co., New York, 1925. \$6.00. 9 x 6 inches.

This North America of J. Russell Smith's book is a wonderful land; its history, its natural resources, its polyglot peoples under few flags, its way of doing things, its future, all are wonderful. And these wonders in their multiplicity of aspects and complexity of relationships and interdependences the author has presented in a virile and stimulating style,—virile because it is free from senile misconception and puerile prejudice, stimulating because it leads, even drives, the reader's thought down new avenues and into new fields.

It is this stimulating presentation of new facts, and of old facts in a new way, that constitutes the most praiseworthy feature of the book. The startling statements that punctuate every paragraph, that characterize nearly every sentence, depend for their impact upon the striking style of the author, not upon undue accentuation, distortion, or extension of fact.

Almost, if not quite, as significant as the stimulating style is the formidable phalanx of facts that the author has conscripted from a thousand and one dependable sources and marshaled into an orderly succession of chapters each with its own purpose and its own power, and each panoplied in its own brilliant style, new and fresh and bright. He shows little tendency to cling to false traditions that have no place in up-to-date science, little inclination to yield to partisan opinion, temporary exaggeration, or imaginative prophecy. His explanations are clear and direct; his illustrations, both textual and pictorial, are pertinent and distinctive. The book is a mine of geographic ore, high in factual content, easily reduced.

It is a comprehensive work that includes every region, every industry, every important commod-

ity of the continent, and selects for discussion the salient features of each. Not much that is significant is neglected; little that is interpretative or suggestive is ignored. Through it all runs a thread of speculative interest, holding the reader and the student to an open mind, impelling them to investigation and research beyond the limits of the book.

In its stimulating style the book borders in places on the sensational and thereby lays itself open to criticism. Geography has not yet so securely established itself as a well-founded science that its teachers can run the risk of offending good taste and bringing down upon their profession the antagonism of the more sedate and conservative, those who sit in calm and careful judgment; Professor Smith comes dangerously near the limit beyond which it is not safe, or wise, to go.

As a whole the book is excellent in form and style and matter. It is informative, stimulating, and provocative of thought and discussion; it has few faults, and many virtues; it is readable and superlatively teachable; how much more may we ask of a book of this kind?

W. ELMER EKBLOW.

DUGGAR, J. F. *Southern Field Crops*. Revised edition. viii and 444 pp.; maps, ill. MacMillan, 1925.

This well-written little book dealing with southern agriculture is divided into three sections. Part I treats the common cereals; Part II, cotton and Part III, such special crops as the peanut, sugar cane, sweet potatoes, tobacco, hemp and the sorghums.

It intends to present a practical discussion of the agronomic problems of the agriculture of the South. It follows the lines previously laid out in such studies. Recently, however, many agronomists are coming to feel the need of a much broader knowledge of these problems. They see the need more and more for an interpretation of crop production and other agricultural practices from the standpoint of man's reactions and interactions to the features of the physical environment of the areas involved. With the aid of the striking advances being made in applied botany and the almost revolutionary progress in the development of soils geography, it is not too much to expect that in the near future well-defined interpretations can be made in the study of the relations of the crop-plant associations to the physical environmental conditions of the sections involved.

E. H. JOHNSON.

HOWARD, ALBERT. *Crop-Production in India*. 200 pp. Oxford University Press, 1924.

This volume is written by the Director of the Institute of Plant Industry, Indore, who was formerly Imperial Economic Botanist of the Agricultural Research Institute at Pusa, and is

regarded as one of the world's foremost students of the problems of applied botany.

The central theme is crop production—the life of the plant in its relation to the physical environment. The plant is considered as the center of the discussion; various soil features are considered in relation to the growth and development of the crop. "Provided the cultivator can supply sufficient water, air, and organic matter, and also maintain a suitable texture, the soils of India are exceedingly fertile and produce abundant crops." Very little study and interpretation has been made of the soils of India from the viewpoint of modern soil geography. The practical problems in regard to the soils which are discussed fully are those dealing with surface drainage and erosion, soil aeration, irrigation and water saving, the nitrogen problem and the alkali situation.

In considering the crops, it is pointed out that India is a land of small holders devoted to the raising of crops, of which there are two kinds. First in area and importance are the food crops—the cereals and pulses which provide food for the population. "The second group comprises the money crops, by which the cultivator pays the land revenue and purchases the necessities of life."

Stress is placed upon the immense field of work in the improvement of crops in India. "More efficient varieties are needed to replace those now cultivated. More intensive methods of agriculture, within the means of the people, have to be devised."

Other well-balanced chapters deal with the physical problems involved in the production of cotton, wheat, rice, sugar cane, fibers, oil seeds, tobacco, the pulses, and fruits.

This is a book very necessary to the student of the agricultural and thus the economic geography of India. It does not pretend to emphasize the problems involved in the areal distribution of the various crops of the country. It does not attempt to interpret the results of economic and other human forces in their reactions to the areally differentiated physical districts as these reactions and interactions have expressed themselves in the present-day areally differentiated "geographic" landscapes of the country. It does provide, however, some very significant material for certain aspects of such a study.

Of great importance also are the carefully selected and rather extensive bibliographies placed at the close of each of the chapters.

E. H. JOHNSON.

Crop Atlas of India. 16 maps, double page. Superintendent, Government Printing, Calcutta, 1923.

The maps show by systems of shading the percentage of the net area cropped in the various political subdivisions of the provinces and states of India. These maps are based on agricultural statistics for the five years ending 1918-19 for

those portions of the country from which returns were available. Each map shows in this way the distribution and relative intensity of the area in crops for the following 16 commodities: rice, wheat, barley, jowar (sorghum), bajra (bulrush millet), sugar cane, tea, coffee, tobacco, cotton, jute, linseed, rape and mustard, sesamum, groundnuts, and indigo.

Insets show by means of figures the average export of the commodities from the various provinces, the average acreage and the average production of each commodity from the various provinces and states and by bar graphs the relative importance of the several provinces in the production of the various commodities.

E. H. JOHNSON.

Memoires sur la nomenclature et la classification des sols. Comité International de Pédologie. Internationales Bodenkundliches Komitee. International Committee of Soil Science. xx and 320 pp. \$2.00. Helsingfors, 1924.

This volume consists of some of the papers delivered at the Fourth International Soil Science Congress held at Rome, May 12-19, 1924. These papers by representatives of European countries are valuable mainly, it seems to the reviewer, in (1) showing the comparative progress in soil science and soil geography in Europe; (2) presenting certain valuable data, as, for instance, the results of chemical analyses of soil, samples taken from the various soil horizons as in the article "Zur Frage der Bodenbildung und Bodenklassifikation" by B. Arnio (Helsingfors) and H. Stremme (Danzig), or the excellent illustrations in color of the different horizons of several kinds of Podsolized soils in "Die Klassifikation der Böden und Bodenarten Finlands" by Professor Frosterus of Helsingfors; and (3) several excellent articles on soil classification, of which the following may be noted: the paper by Professor Frosterus, already mentioned; "Considerations Concerning the Classification and Nomenclature of Soils" by G. Murgoci of Roumania and "Différents types d'après lesquels se forment les sols et la classification de ces derniers" by G. D. Glinka of Petrograd. This latter article has also appeared in English under the title "Different Types of Soil Formation and the Classification of the Resulting Soils" in the International Review of the Science and Practice of Agriculture. New Series. Vol. II, 1924. This latter paper constitutes a summary of the significant characteristics of the zonal types of soils and the varieties thereof as recognized by the leading soils geographer of Europe.

E. H. JOHNSON.

Tull- och traktatkommittens utredningar och betänkanden: (Tariff and treaty committee's investigation and reports). Stockholm, 1920-25.

A Tariff and Treaty Committee has been at work in Sweden since 1919. The main report of

this committee, published in two large volumes has been available since the 5th of June, 1924. The members of the committee included some of the best of Sweden's economists and industrialists. The task of the committee was to investigate in a general way the effects of the present tariff systems and the relations thereof to the problems of the treaty policy of Sweden, for the special purpose of further improving and facilitating economic coöperation within the Scandinavian countries. The report has achieved the objects of not only providing worth-while information, both theoretical and practical, in this respect but has furnished also a good general description of the development of the industries and the relations thereto of the tariffs in Sweden and the other Scandinavian countries and also to some extent in other European countries.

In addition to this main report the committee has completed twenty-eight separate investigations of especially various Swedish industries which are of the greatest value to all who would know thoroughly the industrial life of Sweden and the effects in general of the tariffs in Europe. The results of the several investigations as well as the main report are published only in Swedish but because of their high value and the many illuminating diagrams and tables and the fewer maps, they deserve notice in publications beyond the borders of Scandinavia.

The investigations and reports are as follows:

I. Svensk tullpolitik 1816-1911 av A. Montgomery.

Swedish tariff policies 1816-1911 by A. Montgomery.

II. Bomullsindustriens produktions förhållanden av K. -G. Hagström.

The Conditions of Production in the Cotton Industry by K. -G. Hagström.

III. Utredning angående det svenska jordbrukets produktion samt saluöverskott av spannmål av E. Höijer.

Investigation into the production of cereals by Swedish Agriculture, and the surplus for sale by E. Höijer.

IV. Jämförelse mellan jordbrukets utveckling i vissa delar av Sverige samt Danmark och Norge av E. Höijer.

Comparisons of the development of agriculture in certain parts of Sweden, Denmark, and Norway, by E. Höijer.

V. Tabeller till belysning av det svenska jordbrukets utveckling 1871-1919 jämte anmärkningar av E. Höijer.

Tables to illustrate the development of Swedish Agriculture from 1871-1919 with comments, by E. Höijer.

VI. Svensk traktatpolitik 1816-1914 av A. Montgomery.

Swedish Treaty Policies 1816-1914 by A. Montgomery.

VII. Utåtande angående frågan om differenttullar till skydd mot valutadumping.

- Report concerning the question of differential tariffs as protection against debasement of exchange.
- VIII. Utlåtande i valutafrågan.
Report on Exchange values.
- IX. Utlåtande angående järnvägsfrakternas reglering.
Report concerning the regulation of railway freight rates.
- X. Utlåtande med förslag till förordning om åtgärder till skydd mot så kallad valuta-dumping.
Report with recommendations for the adjustment of duties as a protection against so-called exchange debasement.
- XI. Pappersindustriens produktionsförhållanden av E. Bosaeus.
The Conditions of the Production in the Paper Industry by E. Bosaeus.
- XII. Margarinindustriens utveckling etc. av J. Lublin.
The Development of the Margarine Industry, etc. by J. Lublin.
- XIII. Den svenska kautschukindustriens utveckling 1871-1913 etc. av B. Ohlin.
The Development of the Swedish Rubber Industry 1871-1913, etc. by B. Ohlin.
- XIV. Huvuddragen av det svenska jordbrukets utveckling 1871-1919 av A. Sjöström.
The Essentials of the Development of Sweden's Agriculture 1871-1919 by A. Sjöström.
- XV. Översikt av jordbrukets utveckling i vissa främmande länder 1871-1919 av E. Höijer.
Review of Agricultural Development in certain foreign countries 1871-1919, by E. Höijer.
- XVI. Den svenska järn anteringens utveckling etc. av S. K. Stockman.
The Development of the Swedish Iron Industry, etc. by S. K. Stockman.
- XVII. Den Svenska glasindustriens utveckling etc. av B. Ohlin.
The Development of the Swedish Glass Industry, etc., by B. Ohlin.
- XVIII. Den svenska mekaniska verkstadsindustriens utveckling intill krigsutbrottet av E. Linder.
The Development of Swedish Mechanic Industries up to the Outbreak of the War, by E. Linder.
- XIX. Sveriges bryggeriindustrier av A. Lilienberg.
Sweden's Brewing Industry, by A. Lilienberg.
- XX. Garveriindustriens produktionsförhållanden av W. Smith.
The Conditions of the Tanning Industry, by W. Smith.
- XXI. Kvalitetsfrågan hos det svenska vetet av H. Nilsson-Ehle.
The Question of Quality of Swedish Wheats, by H. Nilsson-Ehle.
- XXII. Översiktstabeller angående den svenska industriens utveckling 1891-1920 jämte anmärkningar.
Summation—tables Regarding the Development of Swedish Industry 1891-1920, with Comments.
- XXIII. De svenska järn- och metallmanufaktur industriernas utveckling etc. av G. Delling.
The Development of the Swedish Iron and Metal Industries, etc., by G. Delling.
- XXIV. Undersökning angående jordegendomsvärdenas utveckling i Sverige och vissa främmande länder av K. Åmark.
(Research concerning the development of agricultural land values in Sweden and certain foreign countries by K. Åmark.)
- XXV. Handels- och prisöversikter rörande spannmål etc. av K. Åmark.
(Trade and prices survey concerning cereals, etc. by K. Åmark.)
- XXVI. Ljusindustrien samt tillverkningen av glycerin etc. av J. Lublin.
(The candle industry and the manufacture of glycerine, etc. by J. Lublin.)
- XXVII. Ylleindustriens produktionsförhållanden av K. -G. Hagström.
(The conditions of production in woolen industries by K. -G. Hagström.)
- XXVIII. Den svenska tegelindustriens utveckling etc. av B. Ohlin.
(The development of the brick industry in Sweden by B. Ohlin.)
- XXIX. Betänkande ang. tullsystemets verkningar i Sverige före världskriget. Del I och II.
(Report on the effects of the tariff system in Sweden before the World War Vol. I and II.)
- XXIX-XXXV. In these volumes it is intended to treat the porcelain industry, the shoe industry, the cement industry, washing-preparations industry, the printing industry, the paper refining industry, monopolistic coöperation within Swedish industries, and the income of Swedish industries for the years 1911-1914.

OLOF JONASSON.

OUR CONTEMPORARIES

THE GEOGRAPHICAL REVIEW

Vol. XV, No. 2. April, 1925

Looking Back at Malthus. 13 pages. Mark Jefferson.

Another joust in the Malthusian tournament, Professor Jefferson takes his turn at the pessimists, and rides them merrily down. A rather interesting paper.

Ancient Trade Routes from Carthage into the Sahara. 16 pages. Count Byron Khun de Prorok.

This is a richly-illustrated and valuable contribution to our knowledge of the Sahara.

The Distribution of Population in the Amazon Valley. 20 pages. W. L. Schurz.

One of the best population studies of South American lands in recent literature, this article adds much to our fast-growing knowledge of our sister continent. The "Amazon Basin is one of the world's great deserts"—interesting indeed! And is it true? Why not; the population is less than one to the square mile!

The James Bay Coastal Plain. Notes on a Journey. 11 pages. E. M. Kindle.

A physiographic and climatic discussion of value.

Explorations in Northwestern Alaska. 18 pages. Phillip S. Smith.

An interesting paper, but with little regarding the resources.

The Earth's Evolution. 9 pages. Sir Napier Shaw.

Notes on the Progress of Dr. Hamilton Rice's South American Expedition. 3 pages.

An Aid to Triangulation. The Use in Secondary Triangulation of Simple Figures Having an Exterior Pole. 13 pages. O. M. Miller.

Swedish Late-Quaternary Geochronologies. 5 pages. Ernst Antevs.

Commercial Geography as a Science: Reflections on Some Recent Books. 10 pages. Isaiah Bowman.

A timely and well-considered discussion of the many recent books dealing with commercial and industrial geography, and a frank evaluation of their merits and defects.

American Geographical Society. (Activities.)

Geographical Record.

Geographical Reviews.

Vol. XV, No. 3. July, 1925

An Expedition to the Laguna Colorada, Southern Bolivia, With a Note on the Recent Occurrence of "El Nino." 22 pages. Frederick C. Walcott.

The Siberian Sea Road: The Work of the Russian Hydrographical Expedition to the Arctic 1910-1915. 32 pages. N. A. Transche.

The Progress of Survey and Settlement in British Columbia. 2 pages. George G. Aitken.

An Expedition to the Kalabit Country and Mt. Murud, Sarawak. 17 pages. Eric Mjoberg.

A New Eskimo Culture in Hudson Bay. 10 pages. Diamond Jenness.

Sea Level Along the Atlantic Coast of the United States and Its Fluctuations. 11 pages. H. A. Marmer.

The Exchange of Populations Between Greece and Turkey. 8 pages. Raoul Blanchard.

Rainfall Conditions as Handicaps to Tropical Development With Special Mention of Australia and the Pacific. 9 pages. Stephen S. Visher.

Gravity Determinations at Sea. 4 pages. C. H. Swick.

The International Geographical Congress at Cairo. 5 pages. H. Baulig.

American Geographical Society. (Activities.)

Geographical Record.

Geographical Reviews.

THE BULLETIN OF THE GEOGRAPHICAL SOCIETY OF PHILADELPHIA

Vol. XXIII, No. 2. April, 1925

An Unfrequented Corner of Wales. 19 pages. Emory R. Johnson.

A Forgotten Land Reawakened. 3 pages. George Cluerg.

Notes on a Summer Voyage to Iceland. 9 pages. Spencer Trotter.

Herbert L. Bridgman. 2 pages. Henry G. Bryant.

Book Reviews.

Geographic News and Notes.

Activities of the Society.

Vol. XXIII, No. 3. July, 1925

St. Augustine and Its Oceanic Spring. 8 pages. G. T. Rude.

The Dairy Industry of Wisconsin as a Geographic Adjustment. 27 pages. Glenn T. Trewartha.

The Expedition to Mount Logan, Yukon Territory. 5 pages. J. Monroe Thorington.

Book Reviews.

Geographic News and Notes.

Activities of the Society.

THE JOURNAL OF GEOGRAPHY

Vol. XXIV, No. 3. March, 1925

Studies in the Geography of Brazil. The Great Interior. 11 pages. W. H. Haas.

This sixth article in the series is a valuable historic and economic summary of the "great interior" of Brazil. The resources, both utilized and potential, are well considered.

The Magic Rug. 7 pages. Florence Stewart.

The Ozark Region of Illinois. A Regional Study in Land Utilization. 10 pages. Ina C. Robertson.

A nicely-organized and well-executed bit of economic geography that leaves little further to be said of this interesting region. It is from such thorough bits of work as this that the final geography of our whole country will be compiled.

British Honduras. 6 pages. George T. Renner.

Another well-done bit of work on a little-known region. In spite of its brevity, it contains a wealth of factual material for both student and teacher.

Obtaining Geographical Material for Schools. 2 pages. Mary J. Booth.

Editorials: "Geography's Distinctive Character." "Niagara, Canada, United States." "Long or Short?" "A Correction."

Vol. XXIV, No. 4. April, 1925

The Resources of Honduras. 14 pages. Nels A. Bengston.

Like the account by G. T. Renner, Jr., on British Honduras in the preceding article this is a compact, fact-laden discussion of a little-known region, with geographic relationships clearly presented.

Notes on Tropical Cyclones. 11 pages. S. S. Visser.

An interesting and valuable paper, showing how significant are the economic effects of these great climatic catastrophes of the tropics.

Romance and Adventure of Scientific Travel. 7 pages. Margaret Bailey.

Motivating the Curriculum Through Geography. 6 pages. Olive Nolan.

Geographical Publications.

Vol. XXIV, No. 5. May, 1925

Studies in the Geography of Brazil. East Central Brazil. 18 pages. William H. Haas.

The final paper of a most valuable series on Brazil, it treats of the East Central region in a most interesting way, and attempts to evaluate the factors that have made this region the best developed in the land.

Natural Resources of Siberia. 12 pages. Stanislaus Novakowski.

In general, too little is known in America of the vast resources of Siberia. This excellent article from authoritative sources should add materially to our knowledge of the possibilities of this great Asiatic domain.

Geographical Publications.

THE NATIONAL GEOGRAPHIC MAGAZINE

Vol. XLVII, No. 4. April, 1925

The Mother of Rivers—The Great Columbia Ice Field of the Canadian Rockies. 69 pages. Lewis R. Freeman.

The Land of the Yellow Lama. 45 pages. Joseph F. Rock.

The National Geographic Society's Yunnan Province Expedition. 6 pages. Gilbert Grosvenor.

Vol. XLVII, No. 5. May, 1925

Through the Back Doors of Belgium. 42 pages. Melville Chater.

Ferns as a Hobby. 30 pages. William R. Maxon.

Marvels of Fern Life. 16 pages. E. J. Geske.

Tracking the Columbian Ground-Squirrel to Its Burrow. 11 pages. William T. Shaw.

Helsingfors—A Contrast in Light and Shade. 16 pages. Frank P. S. Glassey.

Vol. XLVIII, No. 1. July, 1925

Rediscovering the Rhine. 43 pages. Melville Chater.

Pages from the Floral Life of America. 33 pages. Mary E. Eaton.

Bird Life Among Lava Rock and Coral Sand. 31 pages. Alexander Wetmore.

THE JOURNAL OF LAND AND PUBLIC UTILITY ECONOMICS

Vol. I, No. 2. April, 1925

Economic Aspects of Forestry. 9 pages. W. B. Greeley.

Fluctuating Statistical Standards of Public Utility Operations. 14 pages. Homer B. Vanderblue and William L. Crum.

The Field of Land Utilization. 8 pages. L. C. Gray.

Theory and Practice in Land Classification. 16 pages. P. S. Lovejoy.

The Meaning of Public Utility. A Sociological Interpretation. 13 pages. V. N. Valgren.

Public Policy toward Radio Broadcasting. 17 pages. Hiram L. Jome.

Taxation of Land in Austria. 11 pages. John V. Van Sickle.

Growth of Urban Population in the United States. 11 pages. Rosalind Tough.

Department Contents.

Book Reviews.

Summaries of Research.

Comments on Legislation and Court Decisions.

NEWS ITEMS

UNIVERSITY OF CALIFORNIA

DEPARTMENT OF GEOGRAPHY

Prof. Oscar Schmieder has accepted a lectureship for the coming year. He is a pupil of Hettner, since 1919 professor at the Universidad Nacional, Cordoba, Argentina, and student of the geography of the Andes and the Chaco. He has been very active in publishing articles on Latin America in Spanish and German.

John B. Leighly, associate in the department, has been awarded an American-Scandinavian fellowship and will spend next year at Stockholm with Prof. Sten DeGeer, continuing his studies in urban morphology.

C. W. Thornwaite and Peveril Meigs are undertaking some preliminary studies in Baja, California, in preparation for a systematic regional study of that area.

Miss Gladys Wickson is spending the year traveling in Europe and is now registered in geography at the University of London.

INDIANA UNIVERSITY

DEPARTMENT OF GEOGRAPHY

Clifford M. Zurer, who received his M.A. in geography in 1922 at Indiana University, will receive his Ph.D. from the University of Chicago this June. He has been appointed to an assistant professorship in the Department of Geography at the Southern Branch of the University of California.

Wellington D. Jones of the University of Chicago lectured to the Indiana State Conference of Geography Teachers at Terre Haute, Ind., in April, on India and Japan.

S. S. Visser of Indiana University will be a member of the University of Colorado Summer School Faculty this summer. His paper in "Matériaux pour L'Etude des Calamités" has been quite favorably received.

UNIVERSITY OF MICHIGAN

DEPARTMENT OF GEOGRAPHY

The geography staff is cooperating with the Michigan Land Economic Survey in a field study of Sylvan Township near Ann Arbor. L. R. Schoenmann, Wade DeVries, and A. O. Veatch of the survey have visited Ann Arbor to explain the method used in the study of other parts of the state. A group of advanced students is helping

in the field work. The mapping includes the soil, surface roughness, and cover for all units over five acres in extent.

Professor McMurtry will assist the Land Economic Survey in an advisory capacity in the survey of a county in the Northern Peninsula of Michigan next August.

Professor McMurtry's Report on the Economic Geography of the Central Basin of Tennessee is being published by the State Geological Survey of Tennessee.

Five courses will be offered in the summer school at Ann Arbor. Professor James will give "The Elements of Geography," and "Problems in Tropical Geography;" Mr. Hall will give "Commercial Geography," and "The Regional Geography of Asia." Research work for advanced students will also be provided. The survey of Sylvan Township will probably be continued in the summer.

The field camp in Kentucky under Professor McMurtry has already many more applicants than can be accommodated.

Mr. F. A. Stilgenbauer is working on a preliminary study of Prince Edward Island which he will present as his Master's thesis.

CORNELL UNIVERSITY

DEPARTMENT OF GEOLOGY

Miss Helen F. Burt is engaged in a field study of the "Tully Limestone as a Scarp-Developing Formation." Another student, Miss Ruth N. St. John has a problem, the "Superposition and Intrenchment of Meanders of Streams Where the Overlying Formation is Unconsolidated."

Professor Von Engel is personally engaged on a study which has now continued through some years that has for its subject the "Through or Trough Valleys of the Central New York Plateau." This is under the auspices of the New York State Geological Survey. He plans to include in the report a considerable amount of material on the economic significance of these valleys, but the discussion in main will be genetic.

UNIVERSITY OF ILLINOIS

DEPARTMENT OF GEOLOGY AND GEOGRAPHY

Miss Bessie Ashton, for the past three years instructor in geography at the university, will spend the year of 1925-26 at the University of Wisconsin completing work for her doctorate.

Miss Ashton is working on the problem of the geographical aspects of the new Illinois Waterway for her thesis.

Mr. Lee O. Yoder, assistant for the past year, is returning to the University of Chicago where he will continue work leading to the doctorate and also assist in the local United States Weather Bureau office.

Mr. W. O. Blanchard and wife will spend the summer in Europe in connection with a study of the geography of that continent.

Mr. J. B. Appleton, London A.B., Chicago Ph.D., comes to the University of Illinois as assistant professor in 1925. He will teach during the summer at George Peabody College, Nashville, Tenn.

Mr. W. O. Blanchard spent several days studying the effects of the recent tornado in southern Illinois.

Miss Vera Goessling, University of Missouri, and Miss Carol Mason, Clark University, will come to the University of Illinois as assistants in geography in 1925-26.

Enrollment in geography courses (all electives) has grown from 147 in 1919-20 to 650 in 1924-25.

HARVARD UNIVERSITY

DEPARTMENT OF GEOLOGY AND GEOGRAPHY

Kirtley F. Mather planned to sail from Seattle on June 2 in company with R. H. Sargent for a geographic and geologic exploration of a portion of the Alaskan Peninsula, southwest from Chignik.

The Harvard Summer School in Geology will be held in the Canadian Rockies under the directorship of Prof. Percy E. Raymond.

OHIO STATE UNIVERSITY

DEPARTMENT OF GEOGRAPHY

The past year has marked another successful one in the history of the Department of Geography at Ohio State University. The registration in all courses was 2,339, of which total 1,347 were registered in the elementary and 992 in the advanced courses. Six students carried on graduate work toward their Master's degree.

Miss Esther G. Treahey, who has taught in the Columbus schools for a number of years, will receive her Master's degree at the end of the summer quarter. Her thesis is "An Anthropo-Geographical Classification of Islands." Her work is being carried on in both the Department of Geography and Department of Principles of Education.

Mr. R. R. Sharrock, an assistant in the department, will receive his Master's degree in

geography and foreign trade at the end of the summer quarter. The subject of his thesis is "Geographic Factors in the Development of the Trade of the Pacific."

Mr. Karl D. Reyer, a graduate of Ohio State, and an instructor in the School of Business Administration at Ohio University, Athens, Ohio, will receive his Master's degree in June of this year. The subject of his thesis is "Free Ports: The Importance of Geographic Factors in Determining Their Successful Operation, With Special Reference to the Establishment of Free Ports in the United States."

Mr. Harold Fischer, an assistant in the department, will receive his Master's degree sometime during the year 1925-26. The subject of his thesis is "Some Phases of the Economic and Social Geography of Pennsylvania." He is especially interested in industrial geography.

The Department of Geography at Ohio State is rather unique in that it was organized as a part of the College of Commerce and Journalism. However, it has developed in a manner which enables it to serve students in all of the colleges of the university. Eighteen different courses in the field of geography are offered in addition to the seminar and pro-seminars. A staff of eight men conducts the work.

The curriculum in foreign trade in the College of Commerce is under the direction of the department. This curriculum covers a period of four years. It is built upon geography as a base, with fundamental business courses and foreign trade technique as important adjuncts. So far as is known, no other institution in the country offers a four year curriculum in foreign trade similarly organized. The two students who will receive their Master's degree this year are working in the border-line field between geography and foreign trade.

The College of Commerce and Journalism has occupied its new building this year for the first time and in that connection the Department of Geography has been fortunate in receiving sufficient funds to provide equipment and maps of the very first order.

Among the members of the staff the following activities may be noted:

Dr. F. A. Carlson is especially interested in agricultural geography and also in the geography of Latin American countries. He has recently returned from a six months' trip to South America, most of his time having been spent in studying the agricultural geography of certain portions of Brazil. Dr. Roderick Peattie, who gave certain regional courses in the Department of Geology, has joined the Department of Geography. He

now has a textbook on the "Principles of Geography" which will come from the press very soon. He will join the staff at Northwestern University for the current summer. Prof. Eugene Van Cleef will be on leave of absence during the year 1925-26, when he will attend Clark University and will complete a book treating with Finland, the results of his recent studies in that country. Dr. C. C. Huntington, head of the department, has been making observations in the field of land utilization as affected by geographic factors.

The summer quarter staff will consist of Dr. Huntington and Mr. Van Cleef.

UNIVERSITY OF NEBRASKA

DEPARTMENT OF GEOGRAPHY

Miss Ruth McDill, fellow in geography, is a candidate for the Master's degree in June, 1925. Her thesis subject is "Evaluation of Geographic Factors Effective in the Location and Early Development of Lincoln, Neb." Miss McDill will teach during the first summer session at the Illinois State Normal University at Normal, Ill. She was recently elected an associate member of Sigma Xi.

Miss Phyllis Rice, Assistant Instructor in Geography, will receive her Master's degree in June, 1925. The subject of her thesis is "Some Important Geographic Factors in Coffee Industry." Miss Rice will teach summer school at Seaton Hill College, Greensburg, Pa. She was recently elected an Associate Member of Sigma Xi.

Mr. John R. Muhm, assistant in geography, will receive his Master's degree in June, 1925. His thesis subject is "Wayne County, Nebraska, a Type Study in Regional Geography."

Mr. Raymond D. Wood, formerly graduate assistant in the Geography Department, has been appointed to a fellowship at Columbia University for 1925-26. Mr. Wood recently won second prize in a contest conducted by the Chicago Council of Foreign Relations, and open to all citizens of Illinois, on the subject "Significance to America of the Geneva Protocol."

Prof. N. A. Bengtson will teach during the summer at the University of Wisconsin. An article, entitled "The Resources of Honduras" by Professor Bengtson, appeared in the *Journal of Geography* for April, 1925. Another paper, "The Economic Geography of Norway," will appear in a future number of the *Journal of Geography*. Mr. Bengtson has worked in both of these countries and writes from personal experiences in these regions.

Prof. E. E. Lackey of the Geography Depart-

ment is reviewing proof on an elementary textbook which he is preparing in collaboration with a prominent eastern geographer. Mr. Lackey will teach during both summer sessions at the University of Nebraska.

Miss Esther S. Anderson, Instructor in Geography, will teach during the second summer session at the University of Nebraska. An article, entitled "The Sugar Beet Industry of Nebraska as a Response to Geographic Environment," will appear in a future issue of *ECONOMIC GEOGRAPHY*.

CLARK UNIVERSITY

DEPARTMENT OF GEOGRAPHY

Dr. Clarence F. Jones has recently returned from a four months' field trip in South America. Dr. Jones is now teaching geography at the summer session of the University of Iowa, and will return to Clark early in August to conduct a field trip in the Lower St. Lawrence Valley and the Maritime Provinces of Canada.

H. Harrison Russell is spending the month of June in field studies on Cape Breton Island.

Julia M. Shipman, who has been teaching in the State Normal School at New Britain, Conn., has accepted the appointment as head of the Department of Geography at the State Normal School, Glassboro, N. J. George F. Howe, A.M. Clark 1923, succeeds Miss Shipman at New Britain.

Olof Jonasson, Arthur Sibelka, and Elmer Johnson left Worcester early in June for extended field studies in the Northwestern States and Canada. Mr. Jonasson will continue his work at Clark University next year; Mr. Sibelka will return to Hungary to study under Count Teleki at the Geographical Institute of Budapest; Mr. Johnson will join the staff of the Texas Mechanical and Agricultural College, College Station, Texas.

Dr. Burton Clark, who was a student at Clark during the past semester, has accepted an appointment as assistant professor in geography at the University of South Carolina, Columbia, S. C.

List of students who were granted degrees at the June Commencement, their thesis subject and position for the coming year:

Master of Arts Degree:

Atwood, Rollin S.—"The Physiography of the Southern Rocky Mountains." Graduate Student, Clark University.

Mason, Carol Y.—"The Geography of the Cranberry Industry in Southeastern Massachusetts." Instructor, Dept. of Geology and Geography, University of Illinois.

Post, Clarence—"The Distribution and Utilization of the Fuel Resources of West Virginia." Head of the Dept. of Geography, State Normal School, Glenville, W. Va.

Saunders, Richard M.—"Historical Geography of Cape Ann." Instructor, American College, Beirut, Syria.

Swett, Phelps N.—"A Geographic Study of Dairying in Vermont." Head of the Dept. of Geology and Geography, Middlebury College, Middlebury, Vt.

Thomas, Katheryne—"The Industrial Geography of the Kennebec Valley." Instructor, State Normal School, Buffalo, N. Y.

Ph.D. Degree:

Buzzard, Robert Guy—"The Geography of Cape Cod." Head of the Dept. of Geog-

raphy, Illinois State Normal University, Normal, Ill.

McConnell, Wallace Robert—"The Geography of Cincinnati." Head of the Dept. of Geography, Miami University, Oxford, Ohio.

Ridgley, Douglas Clay—"An Experimental Study of Children's Interest in Learning for Themselves About Places in Geography." Associate Professor of Geography, Clark University.

MISCELLANEOUS

R. H. Brown, who receives his Ph.D. from Wisconsin this year, has been appointed assistant professor of geography at the University of Colorado.

ANNOUNCEMENT

The Agricultural Regions of Europe, by Olof Jonasson, a carefully prepared and well illustrated article in the October issue of ECONOMIC GEOGRAPHY begins a series of six articles which, when completed, will constitute a complete and comprehensive treatment of *The Agricultural Regions of the World*.

The second in the series, *The Agricultural Regions of North America*, by O. E. Baker, based on the most accurate and authentic data available at the time of going to press, will follow in the January issue; the third in the series, *The Agricultural Regions of South America*, by Clarence F. Jones, who has recently returned from an extended journey through South America, will appear next April.

The series will continue in succeeding issues with separate articles on *The Agricultural Regions of Asia, of Africa, and of Australia*.

One series of maps of adequate dimension will accompany the articles to indicate these *agricultural regions* and another series to indicate the *regions of land utilization* as fully as accurate data are available. Smaller maps, charts and pictures will further illustrate the articles.

To obtain the complete series of these extremely valuable articles which present for the first time on such a comprehensive and accurate basis the significant divisions of the world's most important industry, it will be necessary to subscribe at once for ECONOMIC GEOGRAPHY, beginning with the October issue.

In addition to this series of articles on agriculture, an industrial series will be initiated soon; every issue will also contain four or five other articles dealing with urban and regional geography, with problems of land utilization, with programs of development of resources, with commerce, with transportation, with health, and with the hundred and one other subjects that are of present geographic interest, all by the most competent and best informed authorities in their respective fields. ECONOMIC GEOGRAPHY is indispensable to the intelligent citizen.

The subscription price for the United States and possessions is \$4.00 the year or \$7.50 for two years. To all foreign countries, \$4.50 the year or \$8.50 for two years. Address ECONOMIC GEOGRAPHY, Clark University, Worcester, Mass., U. S. A.

ECONOMIC GEOGRAPHY

A QUARTERLY journal of Economic Geography published by Clark University for the benefit of geographers, economists, teachers, professional and business men, and all who are interested in the intelligent utilization of the world's resources.

Subscription, \$4.00 the year in the United States and its Territories; \$4.50 the year beyond the borders of the United States.

Only a limited number of the first issue of Economic Geography are available. This issue includes the following articles:

The Relation of Geography to the Timber Supply, W. B. Greeley, U. S. Forestry Service.
Geography and Wheat Production, O. E. Baker, Economist, U. S. Bureau of Agricultural Economics.

The Grain Trade of Montreal, Clarence F. Jones, Professor of Economic Geography, Clark University.

The Coal Resources of Canada, M. J. Patton, Economist, Natural Resources Intelligence Service, Dominion of Canada.

A Land Policy for the Public Domain, George R. Stewart, Agronomist, Utah Agricultural Experiment Station.

Map Studies of Population and Cultivated Lands in Scandinavia, Olof Jonasson, Economic Geographer, Geographic Institute of Stockholm, Sweden.

A copy of this number will be sent to any American address for \$1.25, to any foreign address for \$1.50.

Separates may be obtained as follows:

The Relation of Geography to the Timber Supply, W. B. Greeley, 14 pp. Price, 50 cents.

Geography and Wheat Production, O. E. Baker, 37 pp. Price, 75 cents.

Both Booklets for \$1.00

Send all subscriptions and orders to

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ECONOMIC GEOGRAPHY

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AGRICULTURE

IN agriculture the significance of physical environment is peculiarly simple, direct, and permanent. The character of the industry in the different parts of the world; the variety, the quantity, and the quality of its products; the character, the habits, and the customs of the farmers; and the society based upon agriculture, whether pastoral or industrial; all are determined by the natural environment,—the location, the geologic and topographic character of the terrane, the temperature and the moisture, the drainage and the soil, the vegetation and the animal life.

Upon this basis of physical environment is superimposed a social and economic environment of widespread and pronounced significance, but more complex, more intricate and indirect, more transitory than that of the physical basis upon which its effect is spread. Where population is concentrated and congested, where the mass of the people are non-agricultural and industrial but none the less dependent upon agriculture for their food, their clothing, and the raw products upon which they work, the economic factors of the environment may transcend the physical factors and, for the time, become dominant; the industrial revolution of the eighteenth and nineteenth centuries has induced a corresponding revolution in agriculture that temporarily at least, tends to modify significantly the effect of the physical environment—in some parts of the world to emphasize it, in other parts to overcome it, and even reverse it.

The permanence of the influence of the physical environment upon agriculture is a matter of history—archaeological, traditional, written. As the Scythian plains were part of the granaries of Greece, so they became the granaries of Rome, and later of industrial Europe; as the hillsides of Judea nourished the flocks of Abraham and Isaac, so today the flocks of their descendants graze over the same slopes; as the valley of the Nile is irrigated today so it was in the days of Rameses. The directness of the effect of the physical environment is similar whether it be the stony pastures of Scotland, of New England, or of Switzerland; or the broad fields of Hungary, of Argentina, or of Kansas; or the scrubby maquis of Italy or the thorny chaparral of California. The simplicity of the relationship between physical environment and agriculture is likewise everywhere similar whether it be the lack of moisture in the deserts of Gobi or Atacama; or the freezing winters of Canada or Siberia; or the sandy soil of southern Georgia or northern Germany.

Simplicity, directness, permanence—these are characteristic of the relationship between agriculture and physical environment.